FORTY-NINTH ANNUAL REPORT

OF THE

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

COMMONWEALTH INST.
ENTOMOLOGY LIBRARY
26 APR 1957
SERIAL U.S.A. No
SEPARATE

R. Y. WINTERS, Director

THE NORTH CAROLINA STATE COLLEGE OF AGRICULTURE AND ENGINEERING

STATE COLLEGE STATION
RALEIGH

FOR THE
FISCAL YEAR ENDED JUNE 30, 1926
STATISTICAL SUMMARY FOR YEAR ENDING DECEMBER 1, 1926

FORTY-NINTH ANNUAL REPORT

OF THE

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

R. Y. WINTERS, Director

THE NORTH CAROLINA STATE COLLEGE OF
AGRICULTURE AND ENGINEERING

STATE COLLEGE STATION
RALEIGH

FOR THE
FISCAL YEAR ENDED JUNE 30, 1926
STATISTICAL SUMMARY FOR YEAR ENDING DECEMBER 1, 1926

CONTENTS

	Page
Letters of Submittal	5
Station and Joint Committees	6
Staff of Workers	7
Directors' Summary	9
Financial Statement	10
Publications	12
Report of the Department of Agronomy	13
Report of Department of Animal Husbandry	30
Report of Department of Horticulture	48
Report of Department of Botany and Plant Pathology	58
Report on Agricultural Economics	64
Report on Rural Sociology	66
Report on Marketing	67
Report of the Department of Entomology	68
Report of the Poultry Department	70
Scientific Papers Published	78

LETTERS OF SUBMITTAL

STATE COLLEGE STATION, RALEIGH, N. C.,
February 2, 1927.

HON. A. W. MCLEAN,
Raleigh, N. C.

MY DEAR GOVERNOR:

I take pleasure in transmitting to you the annual report of Dr. R. Y. Winters, Director of the Agricultural Experiment Station of the North Carolina State College of Agriculture and Engineering, for the year ending June 30, 1926.

The report this year shows definite accomplishments along the various lines of research undertaken by the staff of the Experiment Station. Progress has been made with all projects and the farmers of the State continue to look to this Station for leadership in solving agricultural problems.

Very sincerely yours,
E. C. BROOKS, *President.*

January 26, 1927.

PRESIDENT E. C. BROOKS,
North Carolina State College of Agriculture and Engineering,
State College Station, Raleigh, N. C.

DEAR SIR:

I have the honor to submit herewith the annual report of progress in agricultural research of the Agricultural Experiment Station of the North Carolina State College of Agriculture and Engineering. The report contains a summary of the activities and results accomplished during the fiscal year ending June 30, 1926.

Respectfully yours,
R. Y. WINTERS, *Director of Research.*

EXPERIMENT STATION COMMITTEE

(Appointed by Board of Trustees of College)

B. F. Shelton, Speed, N. C.
Clarence Poe, Raleigh, N. C.
David M. Buck, Bald Mountain, N. C.

(Appointed by State Board of Agriculture)

W. A. Brown, Rocky Point, N. C.
R. W. Scott, Haw River, N. C.
E. G. Roberson, Leicester, N. C.

JOINT COMMITTEE ON AGRICULTURAL WORK

(Appointed by Board of Trustees of College)

Robert N. Page, Southern Pines, N. C.
W. D. Laroque, Kinston, N. C.
J. F. Diggs, Rockingham, N. C.
Charles W. Gold, Greensboro, N. C.

(Appointed by State Board of Agriculture)

Clarence Poe, Raleigh, N. C.
O. Max Gardner, Shelby, N. C.
J. Vance McGougan, Fayetteville, N. C.
R. W. Scott, Haw River, N. C.

OFFICERS AND STAFF

of the

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

ADMINISTRATION

E. C. Brooks—President of the College
I. O. Schaub—Dean of the School of Agriculture
R. Y. Winters—Director
C. B. Williams—Vice Director
†F. E. Miller—Assistant Director Branch Stations
F. H. Jeter—Agricultural Editor
A. F. Bowen—Treasurer

AGRONOMY

S. R. Bacon—Assistant in Soil Survey
W. A. Davis—Assistant in Soil Survey
G. M. Garren—Assistant in Plant Breeding
S. K. Jackson—Assistant in Soil Fertility Investigations
R. C. Journey—Assistant in Soil Survey, in Co-operation with U. S. Department of Agriculture
P. H. Kime—Assistant in Plant Breeding
H. B. Mann—Assistant in Soil Fertility Investigations
J. H. Moore—Cotton Technologist
S. O. Perkins—Assistant in Soil Survey, in Co-operation with U. S. Department of Agriculture
C. B. Williams—Agronomist
L. G. Willis—Soil Chemist
R. Y. Winters—Plant Breeder

ANIMAL HUSBANDRY

R. S. Curtis—Animal Husbandryman
C. D. Grinnells—Dairy Investigator
J. O. Halverson—In Charge, Animal Nutrition
E. H. Hostetler—Swine Investigator
C. D. Schiffman—Assistant in Animal Nutrition
F. W. Sherwood—Associate in Animal Nutrition

BOTANY

S. G. Lehman—Plant Pathologist
R. F. Poole—Associate Plant Pathologist

HORTICULTURE

C. D. Matthews—Horticulturist
W. A. Radspinner—Assistant Horticulturist
Robert Schmidt—Assistant Horticulturist
C. F. Williams—Assistant Horticulturist

POULTRY HUSBANDRY

B. F. Kaupp—Poultry Investigator and Pathologist
R. S. Dearstyne—Associate Investigator and Pathologist
W. G. Crowder—Poultryman

ZOOLOGY AND ENTOMOLOGY

Z. P. Metcalf—Entomologist
Elizabeth Haban—Clerk

BUREAU OF ECONOMIC AND SOCIAL RESEARCH

G. W. Forster—Economist
Mrs. H. P. Brigman—Statistical Clerk
Miss Clara Gilbert—Clerk
R. W. Green—Assistant in Economics
R. J. Saville—Assistant in Economics

RURAL SOCIOLOGY

W. A. ANDERSON---Assistant in Sociology
S. R. WINSTON---Assistant in Sociology

CENTRAL STATION

R. J. HARRIS---Foreman

BRANCH STATIONS†

F. E. MILLER---Assistant Director of Branch Stations
R. E. CURRIN, JR.---Assistant Director, Upper Coastal Plain Station, Rocky Mount, N. C., Route 5
F. T. MEACHAM---Assistant Director, Piedmont Branch Station, Statesville, N. C.
S. C. CLAPP---Assistant Director, Mountain Branch Station, Swannanoa, N. C.
CHARLES DEARING---Assistant Director, Coastal Plain Branch Station, Willard, N. C.
E. G. MOSS---Assistant Director, Tobacco Branch Station, Oxford, N. C.
J. L. REA, JR.---Assistant Director, Blackland Branch Station, Wenona, N. C.

---

†Under authority of the North Carolina State Department of Agriculture, co-operating with the North Carolina Experiment Station in Research.

FORTY-NINTH ANNUAL REPORT

OF THE

NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

For the Fiscal Year Ending June 30, 1926

By R. Y. Winters, *Director*

Research work in agriculture for the past year has been conducted in accord with the program previously outlined and approved. At the beginning of the year all research projects were recorded on standard forms and carefully reviewed with the workers responsible for their execution. This has made it possible to bring to a close those projects that were not active or were not yielding results. Other projects have been revised to conform to more recent research methods.

The extension specialists have co-operated with the research staff in suggesting unsolved problems which they meet in the field and have been helpful in criticising proposed research work. Members of the teaching staff of the School of Agriculture and those of technical departments of other schools have co-operated in an advisory way, and where the co-operation has entailed considerable work, members of the teaching staff have become co-workers on the project. Eleven members of the teaching staff have submitted one or more research projects, several of which are related to phases of the station program.

A large portion of the field research work of the departments of Agronomy, Animal Husbandry and Horticulture is done on the branch station farms. The branch stations are owned and maintained by the State Department of Agriculture. The research work conducted at these stations is done in co-operation with the State Department of Agriculture under a joint board selected from and by the Board of Agriculture and the Board of Trustees of the College. In connection with the research work on the branch stations credit is due F. E. Miller, Director of Branch Stations, and the superintendents of each of the stations for their suggestions and the careful way in which they have handled the plat and feeding experiments.

CHANGES IN THE STAFF

The appointment of R. Y. Winters as Director of the Station took effect July 1, 1925, former Director B. W. Kilgore having resigned June 1, 1925. F. A. Wolf, Plant Pathologist, resigned September 1, 1925, and was succeeded by S. G. Lehman, Associate Plant Pathologist. S. G. Lehman was succeeded as associate by R. F. Poole, whose appointment took effect March 1, 1926. W. F. Pate, Associate Agronomist, resigned October 1, 1925, and his successor has not been appointed.

THE PURNELL ACT

The Act of Congress known as the Purnell Act which was approved February 24, 1925, has made available to the Station $20,000 additional funds for agricultural research during the past fiscal year. While the general purpose of the act is to provide a more complete endowment of agricultural experiment stations, the more specific purposes are stated in the Act as follows: "The funds appropriated pursuant to this Act shall be applied only to paying the necessary expenses of conducting investigations or making experiments bearing directly on the production, manufacture, preparation, use, distribution, and marketing of agricultural products and including such scientific researches as have for their purpose the establishment and maintenance of a permanent and efficient agricultural industry, and such economic and sociological investigations as have for their purpose the improvement of the rural home and rural life, and for printing and disseminating the results of said researches." These additional funds have made it possible to better balance and strengthen the agricultural research. During the past year the funds have been applied to studies of farm management and organization, standard of living in farm homes, co-operative marketing membership problems, the relation of feed and sex in beef cattle to quality of meat, and the relation of feeds to the soft pork problem.

FINANCIAL STATEMENT

The following is a certified statement of the receipts from the Treasurer of the United States, supplementary funds from the State Department of Agriculture and sales from the Station farms with a record of their disbursement:

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION,

In Account With the UNITED STATES APPROPRIATION, 1925-1926.

	Hatch Fund	Adams Fund	Purnell Fund
Dr.			
To receipts from the Treasurer of the United States, as per appropriation for the fiscal year ended June 30, 1926, under acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906 (Adams Fund), and February 24, 1925 (Purnell Fund)	$15,000.00	$15,000.00	$20,000.00
Cr.			
Salaries	$13,183.38	$12,666.66	$ 9,764.95
Labor	249.82	73.30	3,978.58
Stationery and office supplies	361.42	3.93	242.82
Scientific supplies, consumable	264.65	387.42	38.20
Feeding stuffs			3,652.54

Sundry supplies	$ 57.41	$	$ 63.55
Communication service	67.66		11.16
Travel expenses	669.18	70.75	1,803.75
Transportation of things	24.51	39.90	27.95
Heat, light, water and power		8.96	
Furniture, furnishings, fixtures			416.50
Scientific equipment	121.97	1,749.08	
	$15,000.00	$15,000.00	$20,000.00

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION,

In Account With FARM AND MISCELLANEOUS RECEIPTS.

Dr.

State Department of Agriculture	$60,000.00
Sales	19,821.62
Bank Overdraft	385.58
Total	$80,207.20

Cr.

Salaries	$39,368.31
Labor	7,510.90
Stationery and office supplies	196.36
Scientific supplies, consumable	646.05
Feeding stuffs	9,377.71
Sundry supplies	2,272.44
Fertilizers	1,569.81
Communication service	633.86
Travel expenses	6,476.97
Transportation of things	442.54
Publications	940.76
Heat, light, water and power	468.36
Furniture, furnishings and fixtures	638.33
Library	185.07
Scientific equipment	314.38
Livestock	3,178.69
Tools, machinery and appliances	1,955.01
Buildings and land	1,824.94
Contingent expenses	2,206.71
Total	$80,207.20

We, the undersigned, duly appointed auditors of the corporation, do hereby certify that we have examined the books and accounts of the North Carolina Agricultural Experiment Station for the fiscal year ended June 30, 1926; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was NOTHING on the Hatch Fund and NOTHING on the Adams Fund; that the receipts

for the year from the Treasurer of the United States were $15,000.00 under the Act of Congress of March 2, 1887, $15,000.00 under the Act of Congress of March 16, 1906, and $20,000.00 under the Act of Congress of February 24, 1925, and the corresponding disbursements $15,000.00, $15,000.00, and $20,000.00; for all of which proper vouchers are on file and have been by us examined and found correct, leaving balances of NOTHING, NOTHING, and NOTHING, respectively.

And we further certify that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and in accordance with the terms of said acts, respectively.

(Seal) (Signed) R. C. BIRMINGHAM CO.,
Attest: By W. E. STEVENS,
Auditors.

A. F. BOWEN,
Custodian of the Seal.

PUBLICATIONS

One general bulletin and three technical bulletins were prepared and published during the fiscal year ending June 30, 1926. These were as follows:

General Bulletin.

No. 248. Anthracnose of Dewberries, by F. A. Wolf; 3,500 copies.

Technical Bulletins.

No. 26. Studies in Treatment of Cotton Seed, by S. G. Lehman; 2,500 copies.

No. 27. Fowl Cholera and Fowl Typhoid, by B. F. Kaupp and R. S. Dearstyne; 3,000 copies.

No. 28. Leaf Scorch Disease of Strawberries, by F. A. Wolf; 2,500 copies.

In addition to these publications, the Forty-eighth Annual Report was prepared and published in an edition of 1,000 copies.

These publications have been distributed to Experiment Station directors and libraries at all the stations. The bulletins have also been sent to the various subject-matter specialists at these stations. Approximately 1,000 copies of Technical Bulletin No. 27 have been mailed to poultry specialists in England and European countries from a list furnished by Dr. B. F. Kaupp. The other publications have been sent to these countries on request.

RESEARCH IN AGRONOMY

Research in the Agronomy Department includes work in soil chemistry, soil fertility, soil classification and mapping, field crop culture and breeding. The work in soil chemistry is concerned with studies of muck soils to discover causes for periodical crop failures; the study of magnesia deficiencies in certain soil types and its relation to plant growth and susceptibility to winter injury. The soil building experiments have for their purpose the study of crop rotations in relation to soil building, soil maintenance and economic production of crops in the three main areas of the State. Soil fertility experiments were conducted in twenty areas of the State on the main soil types to find the most efficient proportion of plant food and the quantities necessary for the most profitable production of crops. The classification and mapping of soils have been continued. This work furnishes the location and area of the principal soil types of the State and forms a basis for the study of plant food requirements and crop adaptation of the different areas of the State. The crop culture work has been concerned with the relation of soil preparation and spacing of crops to production, while the breeding studies have supplied valuable information on economical production, improvement of quality and standardizing field crops.

FERTILITY OF MUCK SOILS

These studies have been concerned with the relation of the acidity of muck soils to their nitrification. Nitrification is active in soils as acid as Ph. 4.3, reached a concentration of 153 parts per million after 32 days incubation. The addition of 64 parts per million of nitrate-nitrogen by an application of nitrate of soda resulted in an increase of only 40 parts per million after incubation. The extent of denitrification indicated cannot be considered great enough to deprive a growing crop of available nitrogen.

Laboratory studies of the chemical changes brought about in the soil of the Blackland Branch Station farm have given no evidence that unfavorable crop response can be correlated with any soil condition that has been determined by chemical analysis.

Acid phosphate has been found to decrease the yield of corn in the field but pure dicalcium phosphate had no measurable effect on soil acidity or on bacterial activity in incubated soils as indicated by nitrification and carbon dioxide evolution. No increase in water soluble iron was noted, although injury in the field is associated with deposition of iron in the nodal tissue.

The addition of stable manure greatly accelerated the evolution of carbon dioxide without affecting any of the other properties of the soil determined. It is possible that the carbon decomposed was that of the manure rather than of the soil, as successive analyses showed no acceleration in the rate of decomposition. There was no evidence that the beneficial effect of manure observed in the field was due to inoculation by bacteria or other organisms nor was there any change in reaction in the soils receiving manure.

As compared with ground marble and precipitated chalk, ground dolomitic greatly accelerated the oxidation of soil carbon during the first two weeks of incubation. Later results showed very little differences between the three sources of lime.

CENTRAL STATION

Cecil Sandy Loam

Relative Value of Different Sources of Nitrogen. Six years of field results in a study of the relative value of different carriers of nitrogen for cotton production have shown that nitrate of soda is the most efficient per unit of nitrogen, when each carrier was mixed with normal amounts of phosphoric acid and potash. When the yield per acre of seed cotton is rated at 100 per cent, the percentage yields for the other materials studied are as follows:

Sulphate of ammonia	91.4
Dried blood	84.3
Calcium cyanamid	77.0
Kanona tankage	69.6

The average yield from plats receiving nitrate of soda and sulphate of ammonia separately was 97 pounds of seed cotton per acre more than was secured on an average from the use of dried blood.

UPPER COASTAL PLAIN BRANCH STATION

Concentrated Versus Low Analysis Fertilizer

A comparison of ready mixed concentrated fertilizers analyzing 16-8-8 and 18-6-6 used at the rate of 400 pounds per acre with mixtures analyzing 8-4-4 and 9-3-3 used at the rate of 800 pounds per acre, showed very little difference in yield. The mixtures of concentrated materials seemed to be just as effective as the less concentrated mixture made from acid phosphate, manure salt and the ammonia derived one-half from cottonseed meal and one-half nitrate of soda.

A Study of the Effect of Different Proportions of Fertilizer Constituents Upon the Yield of Cotton

Varying the amount of phosphoric acid from 6 to 12 per cent in a mixture carrying 4 per cent ammonia and 3 per cent potash at the rate of 800 pounds per acre has not materially affected the yields. Twelve per cent phosphoric acid in the mixture produced no more cotton than 6 per cent. Five per cent ammonia in the mixture was found more profitable than either 3 or 7 per cent. When the percentage of potash was varied from 2 to 6 per cent in a mixture carrying 10 per cent available phosphoric acid and 4 per cent ammonia, the yields have not been affected much by the increase during the past three years.

In a study of the effects of applying different quantities per acre of a 10-4-3 mixture, 800 pounds per acre gave a larger yield than applications of 400, 600, 1,000 or 1,200 pounds. The use of 1,200 pounds showed a decided decrease in yields below that secured from an 800-pound application

per acre. It would appear, therefore, that it requires the use of as much as 800 pounds of this mixture to give the largest and most profitable yield but when much in excess of this quantity is used it seems to have an injurious effect.

Crop Rotations

In this experiment, one, two and three-year rotations are being run with and without legumes. One-half of each of the plats is limed and the other half is left without lime.

As a result of three rounds of a three-year rotation in which crimson clover followed cotton seeded after the first picking and corn with cowpeas broadcast in the corn at the last working, followed by oats and vetch for hay, cotton has averaged 120 pounds more seed cotton per acre annually than when cotton was grown year after year on the same land. In the case of corn for the same period, the average yield was increased from 24.8 bushels where corn was grown continuously on the same land without a cover crop to an average of 43.2 bushels per acre when it was grown in the rotation mentioned above and the legumes after growth were turned into the soil.

For corn, a two-year rotation with cotton was more profitable than was continuous corn. Continuous cotton gave a larger yield than did cotton grown in rotation with corn without a cover crop.

COASTAL PLAIN BRANCH STATION

Norfolk Fine Sandy Loam

Soil Fertility Experiment. This experiment is designed to study the main plant food requirements of the soil for the growth of major crops.

For corn, nitrogen and phosphoric acid have proved most essential, though potash must be added in the fertilizer in small amounts to secure the best paying returns.

For oats and vetch for hay, nitrogen, phosphoric acid and potash are all essential, but potash appears to be least important.

With soybeans, although the use of a complete fertilizer is essential, the use of fairly liberal quantities of potash in the fertilizer mixture is much more important than is the case with either corn or oats and vetch.

The use of lime at the rate of 2,000 pounds per acre every four years broadcast has been found to benefit soybeans and corn, especially soybeans for seed, but has not on an average increased the yield of oats and vetch for hay.

Phosphate Carriers

As a source of phosphoric acid, acid phosphate has thus far been found better than either rock phosphate, soft phosphate or basic slag for cotton, soybeans for seed and oats-and-vetch for hay. The limed end of this field as a whole has produced more with all crops than the unlimed, but the increase has not been uniform or very large.

BLACKLAND BRANCH STATION

MUCK SOIL

Source of Lime. A comparison of hydrated lime, ground limestone and marl when used in varying amounts of from one to four tons per acre has shown that ground limestone is the most efficient. The use of 300 pounds of an 8-2-4 fertilizer when used with lime, resulted in increased yields. Where no lime was used no corn was produced on the muck soils of this farm.

Source of Phosphoric Acid. The use of phosphoric acid, applied in the form of rock phosphate, basic slag or acid phosphate has not materially increased the yields of either corn, Irish potatoes, or oats.

PIEDMONT BRANCH STATION

CECIL CLAY LOAM SOIL

In this experiment a field study is being made on three fields to determine the main deficiencies of this type of soil and the best proportion of fertilizing constituents for different crops. The rotation being followed on the fields is as follows:

First Year—Cotton, rye.
Second " —Corn, wheat.
Third " —Wheat, red clover
Fourth " —Red clover.

Results have continued to show that phosphoric acid and nitrogen are the two main limiting plant-food factors in the production of corn, cotton and wheat. A small amount of potash is essential for all the crops, the quantity for cotton being apparently greater than for the other two crops.

In this experiment, for the past five years, red clover has practically failed on all plats receiving no application of lime, except those which have received the heavier annual applications of phosphoric acid and potash. On the limed ends of plats, except those receiving no fertilizer and single constituents, the red clover has yielded fairly well. Those plats which have been receiving the heaviest applications of phosphoric acid and potash each year with lime every four years have given the largest yields of clover hay. Without lime, the clover has made but little headway after coming up and finally dies out almost completely, except on those plats receiving the heavier applications of phosphate and potash. The results show unmistakably the importance of liberal applications of lime, phosphoric acid and potash for the profitable production of clover on typical Piedmont soils.

CROP ROTATION

The crop rotation studies at this farm are conducted on a clay loam soil and consist of a three-year rotation of corn with cowpeas, wheat and red clover compared with the production of corn and wheat without rotation. The fertilizer applications for corn and wheat have been the same both with and without the rotation. Six crops of corn harvested from the three-year rotation have averaged 13.7 bushels per acre more than the corn

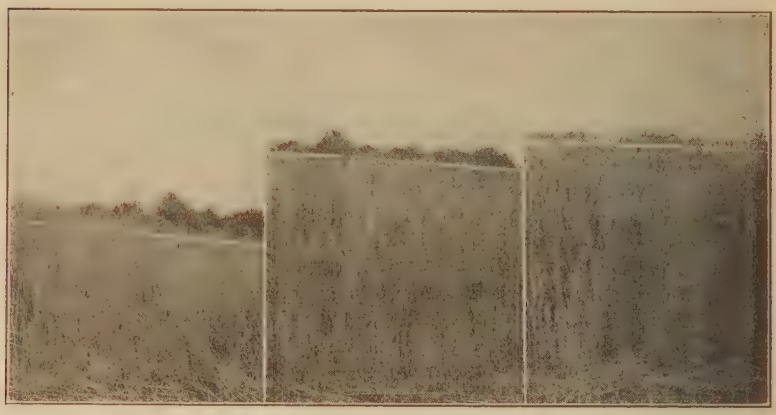
grown continuously without rotation. The wheat in the rotation has averaged 12.7 bushels per acre, while that grown without a cover crop has only averaged 9.4 bushels.

Pedigreed Leap's Prolific Wheat developed at the Piedmont Branch Station and growing at the Mountain Branch Station near Swannanoa.

Acid Phosphate and Rock Phosphate Compared

In these experiments, field results continue to show that acid phosphate is a more efficient carrier of phosphoric acid than soft phosphate rock, when used in normal amounts with nitrogen and potash, for the fertilization of cotton, corn and wheat. When double the normal amount of phos-

phoric acid is derived from the two sources and combined with nitrogen and potash, the acid phosphate continues to be a more efficient carrier of phosphoric acid for the fertilization of cotton and wheat, but not for corn.



A B C

Wheat rotation experiment. A shows wheat with a complete fertilizer only, B complete fertilizer with cowpea rotation, and C complete fertilizer with red clover rotation.

MOUNTAIN BRANCH STATION

Toxaway Loam Soil

Soil Fertility Experiment. The results so far secured show that phosphoric acid is the first and nitrogen the second limiting plant-food factor for the production of corn and wheat on bottom lands. Lime, when used with the proper portions of nitrogen, phosphoric acid and potash, has been very beneficial. Lime used alone has proved profitable for legumes.

Irish Potato Fertilizer Experiment

In a study of the fertilizer requirements for Irish potatoes on this farm, a complete fertilizer has given the most profitable returns. Among the different sources of potash used in the complete fertilizer, sulphate and muriate of potash have given about the same results, both having produced a higher yield than the mixture containing kainit. An application of lime to potatoes has not been found profitable. Although a small amount of nitrogen is essential, potatoes appear to respond up to certain amounts, mostly to application of phosphoric acid and potash.

Sources of Phosphoric Acid

Acid phosphate, finely ground phosphate rock, and basic slag have been compared as sources of phosphoric acid in a complete fertilizer applied to corn, wheat and red clover in rotation. The comparison has been made on plats where lime was applied and without lime. Seven years results

have been secured on this project. During that time the mixture containing acid phosphate has given larger yields of all three crops than the mixture containing finely ground phosphate rock. This was true both with and without lime applications. When applied to plats which received no

Harvesting the 334 strains of rust resistant wheat being tested at the Mountain Branch Station.

lime, the basic slag mixture has yielded 43 per cent more red clover hay than the acid phosphate mixture, but when lime was used in addition, the acid phosphate produced 10 per cent greater yield than the basic slag. When acid phosphate and basic slag were used on the limed plats for corn in the rotation, acid phosphate produced the larger yield by 33 per cent, but when applied to plats without lime, the basic slag plat exceeded the grain yield of the acid phosphate plat by 11 per cent. The wheat yields were greater from plats receiving basic slag, as the source of phosphoric acid, both with and without lime, though the difference in yields between acid phosphate and basic slag was greater from plats receiving no lime.

THE TOBACCO BRANCH STATION

E. G. Moss

Durham Sandy Loam

The tobacco investigations conducted on this farm, near Oxford, for the year 1925-26 have been continued in co-operation with the Office of Tobacco Investigations of the U. S. Department of Agriculture under a similar co-operative arrangement to that followed in the past. The work for the year was enlarged by adding 42 new plats for the purpose of making further studies of the effect of potash, sulphur and chlorine upon the yield and quality of the cured leaves.

"Sand-drown" of Tobacco

"Sand-drown," which is caused by a deficiency of magnesia in the soil, was very noticeable on all plats that had not been limed with magnesian limestone, or the magnesia had not been supplied from other sources, such as the sulphate of potash-magnesia salts. On one series of plats, one-half of which was limed with magnesian limestone six years ago at the rate of one ton per acre broadcast, gave decided results this year in favor of the limed end of the plats. The unlimed half of these plats showed that the supply of available magnesia in the soil was being rapidly exhausted.

Spacing Tobacco

With regard to close planting of plants in the row for the purpose of avoiding course, rough tobacco on land that has too great a supply of nitrogen for tobacco, such as turn-rows, ditch banks and fields previously planted to legume crops, it is believed this may be one of the most effective means of taking care of this problem. On one plat, where a crop of cow-peas or soybeans had been plowed under, every other year for twelve years, 1,000 pounds of an 8-3-3 fertilizer mixture was added and the tobacco was planted twelve inches in the drill, the rows being four feet apart, which would give approximately 10,900 plants to the acre. The tobacco from this plat matured nicely, had plenty of size and body and cured out with good color, and did not have any rough, boney, diseased tobacco in the whole plat, which invariably happens with ordinary settings on soils that have had similar treatment. This is the first year tobacco has been planted as close as twelve inches in the row. The planting, heretofore, has been eighteen inches in the row with excellent results.

SOIL SURVEY

The soil survey has been continued in co-operation with the Federal Bureau of Soils. Seventy-three of the one hundred counties in the State have been surveyed and mapped. A recent tabulation of the soil types according to area in the different soil divisions of the State will give some idea of their relative importance.

I. For Coastal Plain:

Norfolk series	54.0 Per Cent
Portsmouth series	19.0
Coxville series	5.3
Ruston series	2.9
Bladen series	2.6
Hoffman series	2.5
Muck series	2.2

II. For River Flood Plains:

Swamp series	44.0 Per Cent
Congaree series	22.0
Meadow series	9.5
Ochlocknee series	4.6
Toxaway series	3.5
Wickham series	3.4
Kalmia series	3.0
Wehadkee series	1.9

III. For Piedmont Plateau:

Cecil series	49.0 Per Cent
Georgeville series	14.0
Alamance series	7.8
Durham series	6.4
Iredell series	5.5
Appling series	4.4
Granville series	2.7
Wilkes series	2.3
Davidson series	1.5
White Store series	1.5

IV. For Mountain and Plateaus:

Porter's series	74.0 Per Cent
Ashe series	11.6
Chandler series	6.6
Talladega series	3.4
Rough stony land	2.7
Rock outcrop	0.8

Soil Fertility Investigations With Farmers

Each year some fertilizer studies are conducted on private farms. Such work is usually done on soil types or under cropping conditions that are not available on the Branch Station farms. The work consists of finding the best ratio of fertilizing elements for the principal crops of the more important soil types. Thirteen of these experiments were conducted in eleven counties during the past year. The locations, soil type and crops included in these experiments are listed below.

County	*Soil Type*	*Crop*
Wayne	Norfolk Sandy Loam	Corn
Bertie	Coxville Very Fine Sandy Loam	Peanuts
Hertford	Norfolk Fine Sandy Loam	Peanuts
Currituck	Elkton Sandy Loam	Soybeans
Davie	Davidson Clay Loam	Corn
Davie	Iredell Loam	Corn
Wake	Cecil Sandy Loam	Cotton
Northampton	Marlboro Sandy Loam	Cotton
Currituck	Norfolk Loamy Fine Sand	Sweet Potatoes
Gaston		Cotton
Catawba		Sweet Potatoes

The above work was done in co-operation with the Office of Soil Fertility Investigations of the U. S. Department of Agriculture.

CO-OPERATIVE RESEARCH

Effect of Storage of Seed Cotton Upon Certain Chemical and Physical Qualities of the Fibers

The effects of seed cotton storage upon lint has been a matter of much speculation. It is the opinion of some workers in the cotton trade that storage of seed cotton is accompanied by an increase in length of staple. Others are of the opinion that the texture of the lint is improved during storage as seed cotton. For the purpose of securing more definite information on this subject, workers of the U. S. Department of Agriculture and

the North Carolina State College of Agriculture have co-operated. Credit is due P. H. Kime, Assistant Agronomist, for taking charge of the storage and ginning; Frank E. Rice for the chemical studies; H. H. Willis, and other workers of the U. S. Department of Agriculture, for the physical tests. The reports of the studies are as follows:

Chemical Studies

FRANK E. RICE

Professor of Biological and Agricultural Chemistry

I. Preparation of Material. On October 2, 1925, a pile of stored cotton that had been picked a few days previously, was sampled and the samples divided into two parts. One part was at once put through a small laboratory gin (Specimen A); the remainder (Specimen B) was placed in a bag and buried in the pile of unginned cotton until February 23, 1926. On that date Specimen B was put through the same gin previously used. The results obtained at the gin were as follows:

	A	B
Per cent lint	30.9	29.4
Per cent seed	69.1	70.6

Specimen C represents lint that was ginned on October 2, and which was buried in the pile of stored cotton until February 23, when it was again analyzed. With this exception it is the same as Specimen A.

II. Chemical Analysis of the Material. The methods of analysis were as follows:

1. *Determination of Moisture.* Four gram portions of cotton were dried at 105°-106° C. to constant weight.

2. *Determination of Fat* (wax). The portions used for moisture determinations were extracted in a large Soxhlet with anhydrous ether for 12 hours.

3. *Determination of Ash.* Three gram portions were ignited in flat bottom fused silicia dishes in an electric muffle furnace.

The results of the chemical analysis were as follows:

	A	B	C
Moisture	7. 84%	6. 18%	7. 29%
Fat (water-free basis)	0.603	0.619	0.620
Ash (water-free basis)		1. 67	1. 64

On inspecting these results there seemed to be no significant differences with the possible exception of the difference in moisture between specimens B and C. On the assumption that C might possibly be more hygroscopic than B the following experiment was carried out:

Small quantities of specimens B and C were placed in an atmosphere saturated with moisture for a few days and then air dried for an equal length of time. Moisture determination then gave the following results:

Specimen B	5.08 per cent
Specimen C	5.03 per cent

It would seem, therefore, that there is no difference in the hygroscopicity of the specimens and the differences in moisture shown previously were purely accidental.

III. Conclusion. One must conclude that the fat, ash, moisture and moisture-holding power of cotton fiber is not affected by storing from four to five months on the seed before ginning.

Physical Tests

H. H. WILLIS

Associate Marketing Economist, and others of the Division of Cotton Marketing, U. S. Department of Agriculture

The above samples of lint cotton were submitted to the Division of Cotton Marketing for physical examination. The specialist of this office found no difference in the staples, giving each the grade of middling and staple length of 1¼ inches. Portions of the samples were tested for tensile strength by the *Chandler method. Results from these tests are included in the table below:

Table I. The breaking strength in pounds per square inch of Cellulose is listed for each separate test made on samples (A, B and C) of cotton.

Samples	A	B	C
1†	55,900	68,100	73,000
2	73,100	81,500	71,100
3	65,800	81,800	64,900
4	72,200	78,800	78,700
5	85,100	89,700	68,400
6	70,500	64,300	73,300
7	66,900	79,500	73,300
8	70,600	71,300	74,000
9	70,900	72,600	71,300
10	68,900	70,900	68,800
11	81,900	72,800	74,100
12	55,400	73,200	61,500
13	72,500	74,300	69,000
14	59,200	75,300	62,500
15	68,000	74,500	77,100
16	73,900	82,700	68,300
17	71,400	74,000	75,900
18	84,000	68,500	75,100
19	81,800	71,600	75,300
20	73,900	73,900	71,300
Totals,	1,421,900	1,499,300	1,426,900
Average,	71,095	74,965	71,345

*"A New Method for Determining the Strength of Cotton," by E. E. Chandler, Consulting Physicist, U. S. Department of Agriculture, Bureau of Economics, July 1, 1926.

†From six to eight thousand fibers were broken simultaneously in each of the twenty samples tested of lots A, B and C.

The samples of lint had been preserved in tight containers and the breaking tests were performed under uniform conditions of temperature and humidity. The results indicate a slight increase in strength from fibers that have been stored as seed cotton during the period of four months and twenty-one days.

These samples were not spun into yarns, but by applying an estimating equation, which we sometimes use, the strength per skein of 28's yarn of these samples is rated as follows:

A 94.20 pounds
B 95.72 pounds
C 94.28 pounds

Conclusions. The storage of seed cotton during a period of four months and twenty-one days did not change the fat, ash or moisture content of the fibers. The grade and staple were not influenced by storage.

The breaking test indicates a slight increase due to storage, but when this is converted into yarn strength, the increase is very small.

The changes induced by storage in these tests would not warrant the expense and risk of storing seed cotton on the farm for the purpose of improving its quality.

COTTON RESEARCH

Adams Project No. 14

The project consists of a study of the inheritance of the fuzzy seed coat of cotton and its relation to lint production. The project is an outgrowth of the more general project which concerned the inheritance and association of several economic characters. In 1917 and three years following, certain selfed plants of strain No. 43 continued to give rise to offspring having fuzzy seed and others that bore seed free from fuzz. The offspring of these plants segregated in the ratio of three plants bearing no fuzz on the seed coat to one with fuzzy seed. The fuzzy seeded plants bred true, one-half of the naked seeded plants bred true, and the other half continued to segregate in the same manner as stated above. Some questions were raised on account of the origin of the strain and the fact that the genetic history of the original plant was not known. In order to re-check this controlled crosses were made from material that had been self-pollinated during four previous years. The seed from the first generation of this cross were all free from fuzz. In the second generation 716 plants bore seed free from fuzz, and 256 bore normal fuzzy seed, the ratio being 2.95 to 1.05. This established the original results which indicated that the lack of fuzz covering of cotton seed is a simple mendelian character dominant to the fuzz covering.

Since the results of Kearny, McLendon, and others, had shown different conclusions, it was thought best to check the results with the two types from other sources. Selfed material was therefore secured from the Cleveland Big Boll variety and tested in a similar manner. The results from the second generation of this cross were as follows:

225 plants bearing fuzzless seed.
62 plants bearing fuzzy seed.

The ratio of this group is 3.14 plants bearing fuzzless seed to .86 bearing fuzzy seed. In connection with the studies of the Cleveland Big Boll population several strains were isolated that bore seed having a fuzzy tip pattern similar to those of the Egyptian and Sea Island types. The seed of this group have a dense growth of fuzz around the micropyle, or pointed end of the seed. This fuzz pattern extends from the pointed end to approximately the middle of the seed, becoming less dense as it extends up the seed, and leaving the rounded portion of the seed uncovered. This character is being studied further under control conditions.

Fiber Distribution on the Seed Coat of Cotton

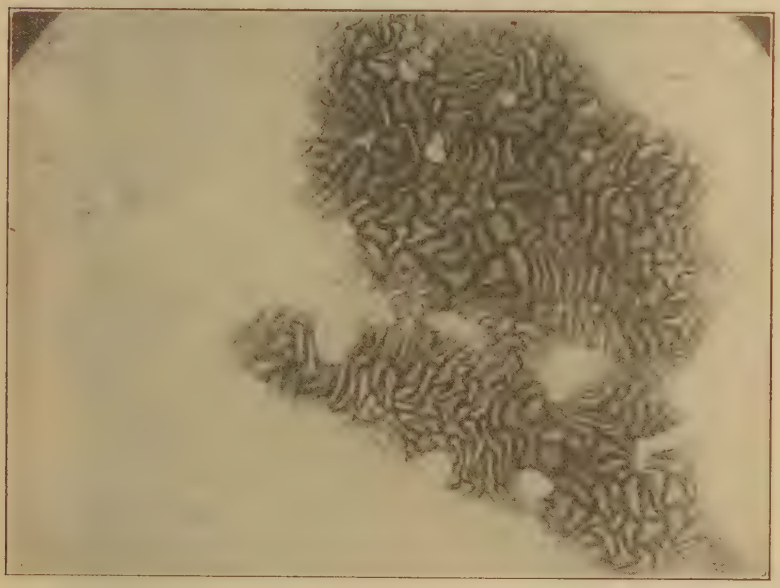
Conducted in co-operation between the Plant Breeding Agronomist and J. H. Moore, Graduate Student.

In order to thoroughly understand variations in physical characters of the cotton fiber it is important to know more about their natural conditions and the inherent characters that influence them. Fiber population and dis-

tribution on the seed coat was thought to have some influence upon fiber qualities. The points which were given attention in this study are as follows:

What method can be used in studying fiber population?
Is there any relation between seed coat veination and leaf veination in cotton?
Does the vein pattern influence the fiber population or distribution?
How is the fiber population distributed over the seed coat?
In what way is the fiber population associated with lint index or lint percentage?

Method. Several attempts were made to reduce the fibers to short stubbs by burning, digestion with sulphuric acid, caustic potash, Sweitzer's solution, and others, so that counts might be made. These failed to give results



Photomicrograph of epidermal cells of the cotton seed coat showing the distribution of fuzz and fibre scars. The large rounded openings were made by the removal of fuzz. The small irregular openings are fibre scars.

because of the irregular action of the chemicals and the deposit of digested cellulose left after the treatment. It was then necessary to use the fiber scar as an indicater rather than the short fiber ends. By treating the dry seeds with concentrated nitric acid for three hours, it was possible to separate the epidermal layer from the remainder of the seed coat. This thin coat, when observed under the microscope, will show the fiber scars sufficiently clear to count the number in the field or to compare different areas of the seed coat. Under this treatment the brown epidermal cells are contrasted with the fiber scars which are colorless. For green material that had been killed and preserved in a weak solution of formalin, direct

staining of thin sections of the seed coat with safranin was found sufficient to differentiate the fiber scars from the epidermal cells. The fibers had previously been removed by hand and the thin sections were cut from definite sections of the seed coat.

The veination of the seed coat was similar though not identical with the leaves of the same plant. There was more variation in the mode of branching among the primary veins of the seed coat than was found in the leaf. In the material observed, variation in mode of branching of primary veins was not accompanied by variation in distribution of fibers. In all of the material studied there was a thinner population of fibers near the pointed end of the seed and along a narrow strip immediately adjoining the funiculus.

Beginning with the micropyle end the fiber population is thinner, becoming thicker toward the calazal region, the densest population being collected around the point of branching of the primary veins. These observations would indicate that the proximity to the main food channels is in part responsible for the greater population in the areas mentioned. It is also true that stomata were found in greater number in the area occupied by the greatest fiber population. Some idea of the change in population may be given by supplying records of counts taken from different portions of the seed coat. For this purpose a line of count from the micropyle end to the top of the rounded end will be used. The line will represent one parallel with the funiculus but on the opposite side of the seed.

Range of Fiber Population on the Seed Coat of Cotton

Area	Av. No. Fibers Per Sq. M.M.
Micropyle end	11.83
Middle	32.19
Upper middle	48.31
Calazal region	131.66

Some Factors Which Influence the Development of Cotton Fiber Cell Wall

Conducted in co-operation between the Plant Breeding Agronomist and R. C. Campbell, Graduate Student.

In the dyeing of cotton manufacturers have experienced a lack of uniform absorption of color. This is said to be due to the presence of immature fibers. The immature fiber lacks the thick cell wall found in the normally matured fiber. They take the shape of a thin undulated ribbon, or a partially closed cylinder made by the longitudinal folding of the ribbon. Fibers of this type are not confined to the immature bolls of the plant, but occur to some extent in normally matured bolls. For this reason it would be better to speak of such fibers as undeveloped rather than as immature.

In this work an attempt has been made to study the relation of the percentage of undeveloped fibers to their position on the seed coat to the location of seeds in the lock and to the location of bolls on the plant. The conclusion drawn from the studies are as follows:

1. The percentage of undeveloped fibers is greatest at the rounded end of the seed, becoming fewer as the pointed end is approached. This, to-

Cotton fibres taken at random and mounted on a slide to determine the percentage of undeveloped fibres.

gether with the previous research on fiber distribution on the seed coat would indicate that the percentage of undeveloped fibers increased as the density of fiber population increases. The percentage of undeveloped fibers on a single seed or plant may also be influenced by variation in length of staple, the area of longer fibers being associated with the greater percentage of undeveloped fibers. These results indicate that the continuous selection for high percentage of lint should be done with caution to avoid the accompanying increase of undeveloped fibers.

When observations of undeveloped fibers were made in different zones of the cotton plant it was found that the smallest percentage were found at the lower and inner bolls of the plant. From this point the percentage increased as bolls were selected toward the outer and upper portions of the plant. This indicates the advisability of keeping the different pickings separate in order to secure uniform samples.

Natural Crossing in Soybeans

A study of the amount of natural cross-pollination in soybeans, has been conducted co-operatively by Plant Breeding Agronomist and P. H. Kime, a graduate student.

Pure purple-flowered and white-flowered strains were isolated from the same variety. Seed of both strains were planted in the same hills. At blooming time, 68 of the white-flowered plants were tagged. Plants were not tagged unless they were in the same hill with a purple-flowered plant which was in bloom. These 68 plants were planted in plant-to-row order. They produced 2,514 plants, 12 of which had purple blooms. These 12 plants were F_1 hybrids, resulting from white blooms being fertilized by pollen from purple-flowered plants. This represents 0.4773 of one per cent crossing. Theoretically this is only one-half of the actual crossing, since the white flowers may be fertilized with pollen from either a white or purple-flowered plant. Therefore, the calculated per cent of crossing would be 0.9546 of one per cent.

Several of these purple-bloom plants were saved and planted the following year in order to be sure that they were hybrids and not chance mixtures. The progeny of all the plants segregated in approximately a 3:1 ratio. The total number of plants produced was 237 purple-flowered, and 75 white-flowered plants, which was a ratio of 3.04 to 0.96.

The above results also show that flower-color in soybeans is a simple one-factor character, with purple dominant.

Experiments were also conducted to determine the amount of crossing which takes place in soybeans from one row to another. The same strains were used as in the first experiment, the white-flowered strain being planted in alternate rows with the purple-flowered strain. The white-flowered strain was harvested and planted the following year. A total of 9,403 plants were produced. Seven of these had purple blooms, representing 0.072 of one per cent crossing.

Source of Crimson Clover Seed

Seed were secured from various sources in the United States and from England, France and Czechoslovakia. Results of tests of three years show that it is a safer plan to buy southern-grown seed than imported seed. English-grown seed were found to produce a late crop and have been more or less a failure. Some French-grown seed have shown up equally as well as seed grown in the South, while others have been total failures. The white-flowered French variety is not adapted to conditions this far south. Czechoslovakia seed have shown up well. While certain strains of imported compare favorably with southern-grown seed, it is risky to purchase imported seed unless it is known positively that the seed are of those stocks which have proven themselves adapted by previous tests. Oregon-grown seed did not compare favorably with southern-grown seed during the season of 1924-25. There was very little difference in the southern-grown seed from different sources.

In closing this report it is wished to give full credit to the different workers and efficient services which they have rendered in the different phases of work in agronomy as follows: To W. A. Davis, S. R. Bacon in the State soil survey; to L. G. Willis and E. A. Davis in the technical soil fertility investigations; to S. K. Jackson and H. B. Mann in the field soil fertility investigations; to R. Y. Winters, P. H. Kime and G. M. Garren in the investigations in plant breeding and crop improvement and in the cultural and seeding experiments with different crops; and to Dr. W. W. Garner and E. G. Moss in the soil fertility investigations with tobacco.

C. B. WILLIAMS, Head, Department of Agronomy.

ANIMAL HUSBANDRY RESEARCH

The research in the Department of Animal Husbandry has been concerned with feeding, breeding and management studies with dairy and beef cattle, swine and sheep. Among the important projects in this field are those which have to do with the relation of feed and sex to the quality of meat from beef cattle, cottonseed meal feeding to dairy cows, soft pork investigations, and nutritional studies with North Carolina-grown feeds. The progress of this work is presented in the following paragraphs:

BEEF CATTLE AND SHEEP

R. S. Curtis

A Study of the Factors Which Influence the Quality and Palatability of Meat

The above title covers the broad subject as applied to this study which is now practically on a nation-wide basis. This Station is working on the particular phase of the subject as given below.

"The Influence of Sex and of Cottonseed Meal Versus Corn on the Quality of Meat."

The object of the work is to determine:

1. Whether sex is a real factor affecting the quality of meat.
2. Whether there is an appreciable difference between meat produced by fattening cattle on an all cottonseed-meal ration and fattening cattle on an all corn ration, using the same kind and amount of roughages in each case.

This project is being conducted in co-operation with the Bureau of Animal Industry, Washington, D. C., and is a part of the Central Experiment Station farm activities. While much valuable data was secured during the first year of the work no conclusive statements will be given out.

The following are some of the striking things brought out in the table:

(a) The steers fed on cracked corn gained .15 of a pound more daily than those fed cottonseed meal, while the heifers fed cottonseed meal gained .21 of a pound more daily than those fed cracked corn.

(b) The steers fed cracked corn dressed out 3.2 per cent more than those fed cottonseed meal, while the heifers fed cracked corn dressed out .7 per cent more than those fed cottonseed meal.

(c) The steers finished on cottonseed meal from an outward appearance indicated that they were equally as fat as those fed on corn, but according to the dressing percentage this was not true. On the other hand, this does not necessarily mean that cattle cannot be highly finished when fed a sole ration of cottonseed meal.

(d) The indications are that cattle finished on a sole ration of cottonseed meal produce a somewhat darker meat than those fed on corn. However, sufficient data have not been secured to make any definite statements.

(e) Additional carcass data is not yet available for publication but will be for a final report on the project.

The steers used in this project were high grade Herefords of uniform breeding, quality and condition, while the heifers were a medium grade of animals, largely of short-horn extraction.

This work is being duplicated this year and conducted in such a way that much more complete data will be secured than from the original study. Since this work was conducted a color chart has been devised for studying color and progress is being made on equipment to determine the tenderness of meat. Other equipment such as experimental ovens for cooking the meat and determining its value in the last analysis, is being devised.

Pasture Grazing Project

This project was originally planned for the purpose of making a comparative study of the pasture grazing capacity of native and tame pastures. The results are sufficiently conclusive to show that there is a striking difference in the pasture carrying capacity of the different grasses.

In each case the cattle had free range on the pastures without any supplemental feed. Those given the run of native pasture on the Swine Research Farm were grazed from April 27 to July 27, inclusive, a period of 91 days. The cattle on the tame pastures of Western North Carolina ranged on the pastures for a period of 106 days to a period of 145 days.

The following table gives the results secured:

PASTURE GRAZING DATA

Native Pasture

No. of Animals	Age	Spring Weight	Fall Weight	Days Pastured	Total Gain Per Animal	Average Dly. Gain Per Animal
24	2 yrs.	9,690	12,219	91	105.4	1.16

Tame Pastures

24	1 yr.	6,520	12,864	109	264	2.4
10	1 yr.	4,320	6,852	118	343	2.9
20	1 yr.	6,420	12,720	103	315	3.0
18	1 yr.	6,334	12,264	100	329	3.3
11	1 yr.	5,680	9,365	106	298	2.8
30	2 yrs.	14,055	24,645	109	353	3.2
9	2 yrs.	4,032	6,680	112	294	2.6
18	2 yrs.	9,122	15,294	112	343	3.0
18	2 yrs.	9,046	14,564	100	362	3.6
26	3 yrs.	19,528	28,010	127	326	2.5
41	3 yrs.	32,284	46,125	145	337	2.3
29	3 yrs.	21,509	30,209	106	300	2.8

254 animals. Average daily gain per animal.....2.83

The following conclusions may be drawn from this work:

(a) The pasture carrying capacity of the tame pastures consisting largely of blue grass produced approximately two and one-half times as much gain as native pastures.

(b) These results show that the only way native pasture can be used to advantage, if at all, is by supplementing with grain. This is not an eco-

nomic practice as pastures form the basis of economical livestock production and unless they are sufficient to do this during the grazing season without supplements they are of little or no value.

(c) It was necessary to take these cattle off the native pasture on July 27, the height of the grazing season, due to insufficient pasturage of a palatable nature. The cattle on the tame pastures were continued approximately two months longer or until about October 1.

(d) The cattle on tame pastures made approximately three pounds gain during the season for each pound gain made by the cattle on native pastures.

This work is being continued by the inauguration of experimental work in Eastern North Carolina which includes pasture carrying studies under the conditions existing in that section.

Beef Cattle Project

This project is located on the Blackland Branch Station at Wenona. It has just been inaugurated and is purely an economic study to secure cost data on production and profits from raising beef cattle in the eastern section of the State. The pasture carrying capacity of both native reed and tame pastures will be carried on in conjunction with the main project.

Eighty acres of land have been fenced for pasture purposes and a water line extended to the field. A purebred Hereford bull has been purchased and also twenty native Eastern North Carolina heifers which will be used as a basis for the work.

A variety of tame pasture mixtures have already been seeded by the Division of Agronomy in tenth-acre plots to determine the most promising pasture mixtures for the Blackland section. In the meantime the native pastures will be thoroughly studied to determine what value they have in beef cattle production. Small representative areas of the pastures will be mowed and weights of the forage taken. This will be done again at the end of the pasture season in an effort to determine as near as possible the actual amount of forage used by the cattle in the herd.

Cost of Raising Lambs to Marketable Age

This project was conducted at the Piedmont Branch Experiment Station at Statesville and will be completely covered in a bulletin now in preparation giving the kind, number of animals used, amount and kind of feeds, pasture and method of management used.

COTTONSEED MEAL FEEDING INVESTIGATIONS IN PROGRESS

R. S. Curtis, J. O. Halverson and C. D. Grinnells

These experiments were begun in order to determine the effect of feeding, to dairy cattle, of rations restricted largely to cottonseed meal and hulls.

When cottonseed meal is fed in large amounts, it is usually considered that it produces harmful results. Practical experience in the hands of feeders have tended to confirm this and to substantiate the assumption that something is wrong with cottonseed meal when thus fed. Previous work at this station has tended to confirm this assumption in that cows

became blind, developed convulsions, aborted and also gave birth to weak, blind calves, some of which had soft bones.

Present experiments are directed along lines tending to show whether these troubles are due to a toxic substance or substances in the meal or are due to the absence of substances necessary for the maintenance and proper functioning of these animals, or possibly due to both.

Recent experimental work in nutrition and nutritional diseases have shown that the absence of necessary food factors in restricted rations may also cause the results previously obtained.

Silver Medal Jersey Cow produced in the herd development work at the Mountain Branch

Cottonseed Meal Studies I

This experiment was designed to determine the effect of graduated amounts of cottonseed meal and corn on reproduction and lactation when minerals and a good quality of roughage are fed. Cottonseed hulls constituted one-third of this roughage.

Four groups of two cows each were used. Group one received fifty per cent and group four 100 per cent of cottonseed meal in the concentrates. The other groups received intermediate amounts of cottonseed meal.

All groups have produced a total of five normal living calves. The amount of milk produced has varied from average to good. One animal in the group receiving a large amount of cottonseed meal in the ration became badly swollen and gaunt. This animal had to be taken off the experiment.

All animals with this exception were fed the usual amount of feed, without any reduction, throughout the hot summer. The animals have been on

these rations the larger part of a year and have consumed relatively large amounts of cottonseed meal as shown in the table (at the end of this report), also cottonseed hulls, of which this constituted one-third of the roughage.

Cottonseed Meal Studies II

This project consists in feeding highly restricted rations consisting of a poor roughage, wheat straw, and meals alone from high oil-bearing seeds, namely, cotton seed, flax, peanut and soybean.

It is desired to ascertain whether the deficiencies of these meals fed separately to calves would cause symptoms simulating those obtained when cottonseed meal and hulls alone are heavily fed. Recently published work states, that in the experimental feeding of peanut meal to pigs, this occurs.

Four groups of three calves each were used. They were fed the meals in the order given above. All animals received minerals and one of each group received, in addition, iron salts.

In group one receiving exclusively, cottonseed meal and wheat straw, there was one death, which was preceded by "fits," the other two animals are partially blind.

Group two, on linseed meal and wheat straw, showed no untoward symptoms.

Group three, on peanut meal and wheat straw, were unthrifty and somewhat nervous.

Group four, on soybean meal and wheat straw, contains one animal totally blind, the other two are apparently normal.

The deficiencies in the rations for the various groups are manifesting themselves but, to date, in not as marked a manner as expected except that of total or partial blindness.

Cottonseed Meal Studies III

To study the effect on growth, reproduction and lactation of dairy heifers, on exclusive feeding of cottonseed meal concentrate, when the quality of roughage is varied, cottonseed hulls and timothy hay were used to vary the quality of the roughage. Minerals were supplied to all animals.

Three groups of two heifers each were used. None of the heifers, so far, have died from this heavy feeding of cottonseed meal; however, one aborted.

Two others, after partuition while producing milk, became lame due to swelling in the joints of the limbs. They finally refused to eat. These animals were in the groups receiving the poorest quality of roughage and the milk produced was probably a drain upon their nutrient reserves. If cottonseed meal has deficiencies and varying amounts of gossypol, it is to be expected that some of the animals in the groups receiving the most severely restricted rations (which includes the roughage of poor quality) would show the effects of such feed. This is what has happened.

Approximate Amount of Cottonseed Meal Consumed Per Day Per 100 Pounds of Live Weight

Expt. and Group	Cow No.	Lbs.
I. Group 1	1	0.2617
	6	0.4203
	218	
2	3	0.6407
	2	
3	304	0.8187
	312	0.7650
4*	303	1.0387
	512	0.9177
II. Group 1*	411	1.0433
	217	0.9413
	313	
III. Group 1*	123	0.8840
	516	0.8357
2*	122	0.8530
	215	0.8193
3*	324	0.8583
	210	1.0930

*On cottonseed meal alone with roughage.

SWINE INVESTIGATIONS

EARL H. HOSTETLER

Projects under the supervision of the Office of Swine Investigations are being conducted at the Swine Research Farm, Raleigh, the Coastal Plains Test Farm, Willard, the Upper Coastal Plains Test Farm, Rocky Mount, and the Blackland Farm, Wenona.

Only two sows and one boar are kept at the Test Farm at Willard, but there are ten to twelve sows kept on each of the other farms for the purpose of producing pigs for experimental work.

A complete list of the projects, by farms, together with the object, record and results are as follows:

SWINE RESEARCH FARM, RALEIGH

J. T. KEESEE, *Foreman and Herdsman*

II. Name of Project: Value of Pasture for Swine

The object of this project is to secure information on the following points:

The value of permanent versus temporary pasture for fattening pigs.

The value of limited versus full feeding (from self-feeders free choice) for fattening pigs on pasture.

The length of time required for a 40-pound pig to reach 200 pounds when fed under the above conditions.

Only four groups of pigs were used in this project because some of the available pigs were transferred to Soft Pork Work, and then too, the dry season was not conducive to good pasture growth. Thirty-two pigs were divided into four lots of eight pigs each and fed by groups as follows:

The pigs in Lot 2 were hand fed a 3 per cent ration of shelled corn and in addition received a mixture of fish meal one-half and linseed meal one-half and mineral self-fed free choice. A good pasture consisting of orchard grass and clover was available at all times.

The pigs in Lot 3 were fed the same as those in Lot 2, except that they also received the shelled corn from a self-feeder.

Alfalfa pasture was grazed by the pigs in Lot 4 in addition to a 3 per cent ration of shelled corn. Protein and mineral supplements were self-fed the same as in Lots 2 and 3. Unfortunately two pigs in this group developed ruptures and had to be taken out of this experiment.

The pigs in Lot 5 were allowed to graze soybeans as their pasture crop but were hand-fed a 3 per cent ration of shelled corn and self-fed the protein and mineral supplements in addition.

The pigs in Lot 3 receiving a full grain ration reached the required weight of 200 pounds in 106 days, while Lot 2 required 154 days, Lot 4, 132 days, and Lot 5, 142 days. However, the concentrates consumed per hundredweight gain in Lot 3 was greater than in any of the other lots. In Lot 2, 367 pounds were required; in Lot 3, 381 pounds; in Lot 4, 346 pounds, and in Lot 5, 344 pounds.

Pigs ready to be turned into corn and soybeans at Upper Coastal Plain Station, Rocky Mount, N. C.

Each group of eight pigs was allowed one acre of the different pasture crops, but so little of the pasture was consumed that it was impossible to compute accurately the cost of the pasture in the different lots, but the data from this one trial show that the pigs fed a limited ration on soybean and alfalfa pasture made more rapid gains on less grain than the pigs that were grazed on orchard grass and clover.

III. Name of Project: Cost of Raising Pigs to Weaning Time

The object of this experiment was to determine the cost of producing pigs to weaning age, or eight weeks. All of the sows, both at Raleigh and at the test farms are included in this project. An accurate record is

kept of the amounts and cost of all feeds for each sow and litter from the time the sow is bred until the pigs are weaned at eight weeks of age. Each sow is weighed when she is bred, when she farrows, and when the pigs are weaned. The pigs are weighed at birth and again when they are weaned.

A summary of the results for the past year include 32 sows from three farms. These 32 sows weaned 384 pigs during the year on an average of 12 pigs per sow. The total cost of the feeds and labor was $1,482.90. These were charged at the following prices: Cereal grains, 2 cents, fish meal 3 cents, linseed meal 2½ cents per pound and labor at 30 cents per hour. Based on these prices the average cost per pig at weaning time or eight weeks of age was $3.86.

Pigs at the Upper Coastal Plain Station after hogging off corn and soybeans.

UPPER COASTAL PLAIN TEST FARM, ROCKY MOUNT

R. E. CURRIN, JR., *Superintendent*
L. O. PAGE, *Herdsman*

I. Name of Project: "Hogging Off" Immature Corn

The object of this experiment was to determine the value of corn when "hogged off" in the dough stage.

Twenty 100-pound pigs and two varieties of corn were used in this experiment. The first variety, Norfolk Early Market, was used solely because of its early maturing qualities, then this was followed by the Jarvis' Golden Prolific variety which matures slightly later and was thoroughly matured before the pigs had finished hogging it down. The pigs were turned into the first field when the corn was in the dough stage and throughout the experiment fish meal and mineral were supplied from a self-feeder to supplement the corn.

Two acres of the Norfolk variety, and 2.9 acres of the Jarvis' variety were used, with the former producing 330 pounds of pork per acre with the addition of 72 pounds of supplementary feed and the latter 542 pounds per acre when 158 pounds of protein and mineral supplements were added. These results from this one trial, indicate that a desirable quality of pork can be produced economically when this method of fattening the spring litters for the September market is used. These data also show that each acre of corn returned a net profit of $40.49 and that each bushel of this immature corn was sold through the hogs for $1.30.

II. Name of Project: Cottonseed Meal for Fattening Pigs

The object of this experiment was to determine if an equal mixture of cottonseed meal and fish meal would be a satisfactory supplement to corn for fattening pigs.

Fifty 80-pound pigs were used in this experiment. They were divided into two equal lots and fed as follows:

Lot 1. Shelled corn, fish meal and mineral.
Lot 2. Shelled corn, fish meal ½, cottonseed meal ½ and mineral.

Both groups of pigs were kept in dry lots during the feeding period and were fed free choice from self-feeders except that in Lot 2 an equal amount by weight of fish meal and cottonseed meal were mixed together before being put into feeders.

No lameness or other ailments common to pigs fed cottonseed meal were apparent during the 55-day feeding period, and the pigs in Lot 2, receiving cottonseed meal, made slightly faster gains on less feed than the pigs that received fish meal alone as a source of protein. In fact, in this one trial the data show that cottonseed meal gave satisfactory results since the pigs in Lot 1 made an average daily gain of 1.44 pounds and required 319 pounds of feed per hundredweight of gain, while the pigs in Lot 2 made an average daily gain of 1.52 pounds and consumed only 302 pounds of feed per hundredweight gain.

III. Name of Project: Hogging Off Mature Corn and Soybeans Grown Together

The object of this experiment was to determine the amount and quality of pork that could be produced from a given area of corn and soybeans, grown together, when hogged off with fall pigs.

The work on this project was begun with 67 fall-farrowed pigs that weighed, on an average, only 41 pounds when they were first turned into the fields. It was, therefore, necessary to break down some of the corn until they made enough growth to obtain sufficient feed without assistance. Fish meal and mineral was supplied in self-feeders in addition to the corn. The experiment was started on November 24, 1925, and continued for 94 days, at which time the total area of 14.5 acres was consumed.

Each acre of corn and soybeans and 160 pounds of protein and mineral supplements produced 484 pounds of pork. At the close of this trial the pigs were shipped to Richmond, Va., where they were sold for the full market price for hard hogs.

The amount of feed consumed per unit of gain was slightly higher and the rate of gain slightly lower than that for pigs that are properly fed in dry lots, but the difference is more than overcome by the saving in harvesting and housing the crop and by the increased productivity of the land due to the manure left on the fields.

The cost per hundredweight for pigs properly fed under dry lot conditions would be approximately $7.00 with the corn costing $1.00 per bushel, but the pigs in this experiment made 100 pounds gain at a cost of only $4.32.

BLACKLAND TEST FARM, WENONA

J. L. REA, JR., *Superintendent*
A. P. LEFEVERS, *Herdsman*

I. Name of Project: Soybean Oil Meal for Fattening Pigs

The object of this experiment was to determine if an equal mixture of soybean oil meal and fish meal would be as satisfactory a protein supplement to corn as fish meal alone.

Two separate trials were conducted during the past year with this project. In the first trial 62 spring-farrowed pigs were fed from July 1 to August 31, 1925. They were divided into two lots of 31 pigs each and fed as follows:

Lot 1. Shelled corn, fish meal and mineral.
Lot 2. Shelled corn, soybean oil meal ½, fish meal ½ and mineral.

Each group of pigs was kept in a dry lot and allowed to choose the feeds from different compartments of self-feeders. Equal amounts of the soybean oil meal and fish meal used in Lot 2 were mixed together before being put in the self-feeders.

The second trial was conducted in identically the same manner as the first except that 58 fall-farrowed pigs were used. These pigs were started on feed January 7, 1926, and continued on experiment until March 15. However, after having been fed for 28 days three of the pigs in Lot 2 developed a condition similar to paralysis and after 42 days eight pigs in Lot 1 and 15 pigs in Lot 2 were similarly affected. They were, therefore, taken off of the experiment and the pigs that remained were given access to a green rye pasture for a short period each day from then until the close of the experiment and no more difficulty was experienced.

A summary of these two trials is shown in the following tables:

TABLE 1
First Trial

Lot No.	No. of Pigs	Average Initial Weight	Average Daily Gain	Feed and Cost Per Cwt. Gain				Cost*
				Shell Corn	Fish Meal	S. B. Meal	Mineral	
1	31	102	2.03	334	28		1.1	$8.05
2	31	101	2.03	295	34	34	.8	8.25

*Corn $1.20 per bushel, fish meal $65.00, S.B. meal $50.00, mineral $20.00 per ton.

TABLE 2

Second Trial

Lot No.	No. of Pigs	Average Initial Weight	Average Daily Gain	Feed and Cost Per Cwt. Gain Shell Corn	Fish Meal	S. B. Meal	Mineral	Cost**
1	29	95	2.04	343	34		1.9	$6.00
2	29	94	1.90	309	28	28	1.3	6.23

**Corn 85c per bushel, fish meal $64.00, S.B. meal $48.00, mineral $20.00.

COASTAL PLAIN TEST FARM, WILLARD

I. Name of Project: The Family Sow

The object of this experiment was to determine the annual cost of maintaining two purebred sows and one purebred boar and their offspring under general farm conditions where all possible waste feeds are utilized, and to promote "up-grading" of swine in the community by keeping a good purebred boar available for outside service at a nominal charge.

Two purebred Duroc Jersey sows and one purebred boar of the same breed were kept on the farm. Each sow produced two litters of pigs during the year and these were either sold to farmers in the community for breeding purposes or used to salvage the waste feeds on the farm and then sold for pork.

While this project appears to be popular with the farmers adjacent to this farm, sufficient data are not yet available from which to draw definite conclusions.

REPORT ON SOFT PORK EXPERIMENTS IN PROGRESS

EARL H. HOSTETLER AND J. O. HALVERSON

Soft Pork Experiment XIV (A, B and C).

To study the effect of corn alone, also corn and cottonseed meal (6:1) as hardening agents following the softening peanut ration, which has rendered pigs of 65 and 35 pounds initial weight soft.

Eight fall-farrowed pigs were used, six each, in groups A, B and C. All pigs were individually fed except Group C which was group fed. All groups were fed the softening peanut ration until soft when the ration was changed as given below:

Group A: (a) Three pigs of 65 pounds each in weight were given corn and supplements as the hardening ration until reaching marketable weight. (b) Three pigs of similar size were likewise fed corn and cottonseed meal (6:1).

Group B: Three pigs of 35 pounds each were individually fed corn and supplements; also three pigs corn and cottonseed meal (6:1) as in Group A.

Group C: Six pigs of 65 pounds each in weight were group-fed corn and cottonseed meal (6:1).

We were unable to obtain uniform and satisfactory gains in weight on all groups, likewise to obtain sufficient hardening of carcasses.

The groups were changed to hardening feed at rather heavy weights and had consumed large amounts of peanuts averaging respectively, 58, 89 and 58 pounds of peanut oil per pig in each group.

***Soft Pork Experiment XV (A and B).**

To study the effect in groups A and B respectively, of milo and sweet potatoes as hardening agents following the feeding of the softening peanut ration which has rendered the pigs of 65 pounds each in weight, soft.

Group A: Six pigs were fed milo with supplements until of a good marketable weight, with fairly good gains.

These pigs consumed peanuts containing an average of 55.61 pounds of peanut oil per pig followed by ground milo. The chemical analysis of the fats and the Soft Pork Committee grade show four out of six hard or medium hard and two medium soft.

Group B: Likewise four pigs were fed sweet potatoes with one part grain supplements to seven parts sweet potatoes. These pigs did not gain as well as expected, probably due to heavy feeding of the bulky sweet potatoes. There was not enough hardening of the carcasses to render them firm. Two graded medium soft and two soft.

***Soft Pork Experiment XVI (A and B).**

To study the relation of hardening to softening feed in lot feeding (using corn and Brewer's Rice with supplements), i.e., the relation between oil and starch intake in lot work in order to obtain hard hogs.

On Softening Feed

Twenty-four 65-pound pigs were fed the softening peanut ration until they became soft, after which they were divided into two equal lots of 12 pigs each as follows:

Lot A. Corn with supplements were fed for eight weeks when the four largest were shipped to Beltsville, Md., for slaughter and grading.

At the end of 12 weeks the eight remaining pigs being of marketable weight, were also shipped.

Lot B. The 12 pigs in Lot B were treated the same as those in Lot A except that they were fed Brewer's Rice instead of corn.

***Soft Pork Experiment XVI-E.**

To study the effect upon the carcasses of pigs of 40 pound initial weight, that have been fed shelled peanuts in a dry lot for eight weeks, followed by a ration of shelled corn, fish meal and minerals, for period of 4, 8, 12 and 16 weeks.

Twelve 40-pound pigs were fed together in one group in this experiment. They received shelled peanuts and mineral, self-fed, free choice, for 56 days and were then changed to a hardening ration of shelled corn, fish meal and minerals, self-fed, free choice. During this hardening period three representative pigs were slaughtered after having been on these feeds for 27 days, three others were slaughtered after 55 days on hardening feeds and the remaining five pigs were continued for 88 days before being slaughtered. One pig in this group became sick and was discontinued.

---

*Included in Co-operative Soft Pork Investigations.

The Experiments XVI-A and B and E are a part of the larger soft pork project conducted by the Federal Bureau of Animal Industry and the State Agricultural Experiment Stations co-operating. As yet sufficient data are not available from which to draw definite conclusions.

SUMMARY OF NUTRITIONAL PHASES OF SOFT PORK INVESTIGATIONS, 1921-1925

J. O. Halverson and Earl H. Hostetler

Pending the publication of the soft pork work in bulletin form, some results are given with partial proof.

The Effect of the Various Amounts of Peanut Oil Consumed on Condition of Carcass

A series of five experiments have been completed in which 5 to 10 pigs in each experiment were individually fed carefully-balanced rations containing graduated amounts of shelled peanuts and a peanut meal high in protein (without hulls). Each ration contained approximately the same amount of digestible protein. The per cent of peanut oil in the ration, however, was graduated for the different pigs, being increased by using more shelled peanuts and less peanut meal.

Pigs of 38 pounds to 150 pounds were used in these experiments in order to ascertain the effect of the varying amounts of the peanut oil ingested upon the condition of carcass at the time of slaughtering.

A representative experiment using 67-pound pigs, is given in Table 1.

TABLE 1—EXPERIMENT IV

Influence of Various Amounts of Total Oil Ingestion on Condition of Carcass

Pig	Lbs. Initial Wt.	Final Wt.	Average Daily Gain	Lbs. Oil Ingested	Carcass Grading Chemical	Fat Analysis Refractive Index Back	Kidney
6	84	273	1.73	23.7	M.H.	1.4600	1.4591
1	56	195	1.27	15.2	S	1.4618	1.4602
2	58	191	1.22	38.1	O	1.4621	1.4613
3	64	215	1.39	53.4	S & O	1.4630	1.4620
4	64	202	1.27	70.8	S & O	1.4630	1.4620
5	75	245	1.56	149.9	S & O	1.4632	1.4624

TABLE 1—(Continued)

Influence of Various Amounts of Total Oil Ingestion on Condition of Carcass

					Feed Given In Pounds Per Mix*					
Pig	Iod. No. B	Iod. No. K	M. Point B	M. Point K	Corn	Starch	Peanuts	Peanut Meal	Wheat Middlings	Linseed Meal
6	64.7	59.4	37.3	42.4	60				30	5
1	65.6	70.4	25.8	39.8	20	5		65		
2	76.2	72.8	24.8	36.0	18		15	55		
3	75.6	77.3	22.1	31.4		4	28	52		
4	82.8	80.0	23.4	34.5			39	44		
5	92.3	81.8	21.3	29.9			100			

*The table gives only those constituents in the ration which materially affect hardness of carcass. All rations contain supplements of minerals and alfalfa except pigs 5 and 6. Pig 5 received minerals alone; pig 6 received the usual corn ration, being fed to the stock hogs. Each mixture approximated 100 pounds.

It will be seen from Table I that the total oil ingestion for pig 6 is 23.7 pounds obtained from corn, middlings and tankage. The other five pigs receiving peanut meal or peanuts, or both, ingested amounts of oil which varied from 15.2 to 149.9 pounds. In the case of pigs 1 and 2 a small amount of the oil was derived from the corn included in the ration.

Table I also shows the progressive softening of the body fats with the increase of total oil ingestion. This softening is shown by the chemical analyses of both the back and kidney fats. It is seen that there is a gradual rise in the refractive index from 1.4618 in the case of the back fat of pig 1, to 1.4632 for the corresponding fat on pig 5. The iodine numbers of these fats exhibit a similar gradual variation from 65.6 for pig 1 to 92.3 for pig 5, while the melting points steadily drop as the refractive indices and iodine numbers increase.

The fat constants of pig 5 closely check those found by Ellis and Isbell† on a group of 16 pigs fed heavily on peanuts. Results in Table 1 show that the fats from the pigs ingesting increasing total amounts of peanut oil approach the chemical composition of peanut oil itself which has a refractive index of 1.4625, and an iodine absorption number of 93.7‡. The refractive indices of pigs 3, 4 and 5 ingesting respectively 53.4, 70.8 and 149.9 pounds of oil exceed the refractive index of peanut oil. The refractive indices of the kidney fats are likewise affected and approach that of the peanut oil.

Pig 6 is representative of the check pigs in these experiments. This pig on the usual corn ration, however, ingested a slightly greater amount of oil than did pig 1 on the ration consisting of peanut meal 3 parts to corn 1 part. The ration of pig 6 contained 3.58 per cent oil, while that of pig 1 contained 3.65 per cent. Likewise, the total amount of oil ingested by each pig differed by only 8.5 pounds. Yet the body fats from the two pigs exhibited considerable difference in firmness and chemical composition, the fats of pig 6 being the firmer. The carbohydrate part of the ration of pig 6 consisted of corn and wheat middlings which influenced the composition of the deposited fat, causing a synthesized firmer fat. On the other hand, the effect of the oil in the peanut meal and peanuts substituted in part in place of corn causes a softer fat to be laid down in the body.

Pigs 1 to 5, fed a ration containing more oil in place of carbohydrates, have laid down the more oily or softer fats with consequent change in composition of the body fats which change depends upon the amounts of peanut oil ingested. It is fairly well known that ingested oil from the ration is laid down in the animal body with but slight change in composition with the exception of cottonseed oil.

---

†N. R. Ellis and H. S. Isbell, Jr. Biol. Chem., LXIX 225, 1926.
‡U. S. Department of Agriculture, Dept. Bull. 1407, p. 13.

From the series of experiments, of which IV is representative, one reaches the conclusion that the softening effect of feeding peanuts or peanut meal is due to the amount of peanut oil which is ingested. The effect produced depends closely upon the total amount of peanut oil ingested.

Arrangement of hog lots at the Swine Research Farm, Raleigh, N. C.

The Effect of a Carbohydrate Ration and Low Oil Ingestion On Condition of Carcass

Since the cereals when fed to hogs produce, as is well known, a firm body fat, and since they consist chiefly of carbohydrates among which the starches predominate, it was desirable to determine if the hardening of the carcasses depended chiefly upon the amount of carbohydrates present.

A series of experiments have been completed in which various amounts of cereals have been fed in which starch predominates and in which the oil content is relatively low compared to that contained in a peanut ration. Below Experiment VIII is given in which corn and Brewer's Rice were compared, being fed subsequent to the feeding of moderate amounts of peanuts.

TABLE 2—EXPERIMENT VIII

Effect of Corn and Brewer's Rice and Low Oil Ingestion on Condition of Carcass

Pig	Initial Weight	Final Weight	Av. Daily Gain	Lbs. Peanut Oil Ingested	Lbs. Oil Ingested on Corn and Brewer's Rice	Lbs. Total Oil Ingested
9	32	197	0.83	35.85	12.71	48.56
10	32	204	1.02	35.69	13.98	49.67
11	32	204	1.02	34.86	3.05	37.93
12	36	204	1.00	35.82	3.05	38.87

TABLE 2—(Continued)

Effect of Corn and Brewer's Rice and Low Oil Ingestion on Condition of Carcass

Pig	Fat Analysis Refractive Index Back	Kidney	Iod. No. B	K	M. Point B	K	Peanuts	Corn	Brewer's Rice
9	1.4590	1.4582	68.44	60.21	37.8	41.2	92.7	92.7*	
10	1.4589	1.4579	65.89	58.20	39.2	43.4	92.7	92.7	
11	1.4579	1.4571	57.82	52.35	39.5	43.0	92.7		92.7*
12	1.4577	1.4571	56.82	50.24	40.5	44.5	92.7		92.7

The amount of oil derived from the peanuts and consumed by each pig is approximately 36 pounds. The pigs were then changed to the hardening ration. Pigs 9 and 10 received corn with minerals and alfalfa, while pigs 11 and 12 received Brewer's Rice in place of the corn. The amount used in the ration of Brewer's Rice and corn was the same as that of the peanuts previously.

As a result of feeding these hardening rations, the carcasses of pigs 11 and 12 receiving Brewer's Rice were considerably firmer than those of pigs 9 and 10 receiving corn. This result cannot be ascribed to a greater consumption of hardening feed. These pigs consumed but 37.3 pounds less and 1.9 pounds more respectively, than did pigs 11 and 12. The amount of peanuts eaten and consequently the peanut oil ingested, was practically the same for all the pigs, the extreme variation of oil differing by only 0.99 pound. Since the pigs were begun on peanuts at the same initial weights, were slaughtered at the same weights within a few pounds of each other, and made fair average and comparable gains, the difference in hardness must be due to other causes. The rations also appeared to be adequate for growth. No stunting effect was apparent. We attempted to eliminate such extraneous factors in studying the effect of feed upon the condition or firmness of carcass.

Among factors to be considered are the composition of the hardening feeds themselves which the two pairs of pigs received. Pigs 9 and 10 ingested during the hardening period, respectively, 4.16 and 4.58 times as much oil from the corn ration as did pigs 11 and 12 on the Brewer's Rice. This amounted to 12.71 and 13.98 pounds, compared to 3.05 pounds oil each consumed in the Brewer's Rice ration by pigs 11 and 12. There is an average difference of corn oil consumed of 10.73 pounds which has a softening influence as has been shown by Ellis and Hankins†. In addition, Brewer's Rice contained an approximate average of 15.43 per cent more starch than did the corn, that is, corn contains only 77.4 per cent as much starch while corn in addition contained 8.4 times as much oil. Both these factors in the corn ration operate to produce softer carcasses. Or, in other words, there is an absence of an appreciable amount of oil in the ration of the pigs

*Hardening feed with minerals and alfalfa fed subsequent to softening feed. Each mixture approximated 100 pounds. They included minerals and alfalfa. Pig 9 was 77 and 85 days, respectively, on peanuts and corn. Pigs 10, 11 and 12 were 77 and 91 days, respectively, on peanuts and hardening feed.

Pigs 9, 10, 11 and 12 were respectively changed to hardening feed at 93, 93, 91 and 94 pounds.

†N. R. Ellis and O. G. Hankins, Jr. Biol. Chem. LXVL, 101, 1925.

on Brewer's Rice, being less than 1 per cent, and there is present an appreciably larger quantity of starch from which a very firm fat is deposited.

The refractive indices of the fats of pigs 11 and 12 on Brewer's Rice are lower than those reported by Ellis and Isbell* while the iodine absorption numbers are not as low. These pigs ingested almost 36 pounds of peanut oil from the peanuts previously consumed. Knowing the persistent effect of peanut oil on the firmness of body fat, the iodine numbers would not be expected to be as low as where the carbohydrate ration of Brewer's Rice had been continuously fed throughout the experimental period. It is rather interesting that the refractive indices for both pigs should be lower, 1.4579 and 1.4577, than that given (1.4582) by Ellis and Isbell. The chemical constants of the fats from pigs 9 and 10 on corn following peanut feeding closely check those of the above investigators in melting point and refractive index while the iodine numbers are slightly higher.

From results obtained in this and other experiments, it is concluded that the firmer fats and carcasses were produced by the rations containing the larger amounts of carbohydrates estimated as starch† and also containing the least amount of softened fat or oil.

The Relation of Carbohydrates, Represented by Starch, to Oil Intake In Hardening Hogs

The relation and effects of peanut oil to carbohydrates estimated as starch in their influence on firmness or lack of firmness of carcass has been pointed out in the discussions above.

It was attempted in three experiments done at different times, to produce firm carcasses, after feeding definite and fairly large amounts of oil derived from the peanuts, by using the least possible amount of feed which would produce a firm carcass. Brewer's Rice which had shown marked hardening effects, was used. The amount of Brewer's Rice was based upon the relation of the energy value of pure starch to pure oil, which was 2½ parts to 1 part respectively. The 60 and 120-pound pigs which were used made good gains in weight. The carcasses of these hogs showed considerable hardness. The judging data was substantiated by the chemical fat constants of iodine absorption number and melting points while the refractive indices indicated a softer fat.

When smaller pigs as in Experiment VIII (Table 2) are used or when gains on hardening feed are unsatisfactory, that is below the average, larger amounts of the hardening feed would be required in order to obtain the same degree of firmness in the fat. Experiment VIII shows that corn does not produce as hard a fat as does an equal amount of Brewer's Rice when fed to pigs that have been previously fed on peanuts. Recently published results in regard to the composition of the fatty acids in the fat laid down from rations consisting of corn and tankage and from rations containing peanuts, confirm these results‡.

---

*Loc. Cit., p. 224.
†Carbohydrates were estimated as starch by the malt diastase method.
‡N. R. Ellis and O. G. Hankins, Jr. Biol. Chem. LXVI, No. 1, 121, 1925.

ANIMAL NUTRITION

J. O. HALVERSON

Effect of Diets Upon Growth, Reproduction and Rearing of Young With Laboratory Animals

Last year we found that a cereal ration without the use of whole fresh milk and cabbage was not successful in reproduction and in the rearing of young. The addition to the ration of the ash, of whole milk or of cabbage equivalent to the amount of whole milk or cabbage consumed by each rat per day was not effective. The addition of five per cent alfalfa leaf improved the ration whether a synthetic or a colony stock ration was used.

Later alfalfa leaf and cod liver oil have been added to all colony rations. In addition more protein, both vegetable and animal, as well as wheat embryo in various quantities, have been added. The results on reproduction and on the rearing of young have been rather marked. The lots of rats receiving rations containing the additional wheat embryo did not thrive nor do as well as did those lots of rats to which more proteins were also added in addition to the wheat embryo. The lots of rats receiving only the added embryo in the ration contracted disease more readily and did not live as long.

Other results obtained on these rations were a pronounced effect on the age at which rats had their first litter, this time on certain rations, being reduced from 128 and 129 days to 76 and 88 days.

There was also a noticeable effect on the fertility of the females and on the average number of young born per litter. The per cent of infant mortality was affected.

The results of this work involving the use of colony rations is now being studied in a statistical manner, partial results of which are given above.

The results obtained on reproduction and rearing of young have so far been more successful with the colony rations than with the rations containing peanuts, as the chief source of protein.

R. H. RUFFNER,
Head of Department.

RESEARCH IN HORTICULTURE

The research progress includes research projects with apples and peaches of the tree fruits, grapes, dewberries and strawberries among the small fruits, pecans among the nuts, and sweet potatoes, Irish potatoes, lettuce and tomatoes among the truck crops.

Emergency conditions arise which require immediate action on the part of the station worker, and an expansion in the research program to take care of them. As an example, the cases of the lettuce and peach growers may be noted. The lettuce industry has been seriously threatened by the development of the trouble known as "lettuce tipburn," an injury which has caused severe losses to lettuce growers. The Station immediately outlined and put into operation an investigation dealing with this trouble. No solution has as yet been worked out, but much valuable information relative to the trouble has been determined.

During the last few years many peach trees have been killed as a result of winter injury in the Sandhills section of the State. In 1925 it was estimated that over 100,000 trees were destroyed. The Station inaugurated projects dealing with this problem and expects to secure valuable information for peach growers to assist them in protecting the trees from this injury.

Summer Apple Varieties

The trees in this experiment have been of bearing age for several years and have produced four crops during that time. Notes on the general production of the orchard and on the production of individual varieties have been made.

Of the varieties tested Liveland Raspberry, Williams, Yellow Transparent and Eckles Sweet Red June have given the best results. Where local markets exist or where rail facilities are good, the production of summer apples in Eastern North Carolina will prove profitable.

Training and Pruning Apple Trees

This project was outlined to study the comparative value of the open head and the modified leader systems of training, to secure information on the amount of annual pruning most desirable, and to determine the relation of these factors to early bearing and to the production of large trees.

The trees for this project were planted at the Mountain Station in 1919, and at the Piedmont Station in 1924. These orchards were divided into blocks in which open head and modified leader systems of training have been followed and in which light, medium and heavy pruning has been practiced. The measurements of the growth of each tree have been secured and recorded. Crop records have been secured from the trees at the Mountain Station.

The following table supplies information on the effect of different degrees of pruning on early bearing and on yield.

VARIETY	AGE	DEGREE OF PRUNING					
		HEAVY		MEDIUM		LIGHT	
		Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
Rome	7	2	6	10	3	26	6
Winesap	7	0	12	14	8	35	4
Stayman	7	7	12	23	13	30	0
Delicious	7	0	0	8	8	15	0

These results show that lightly pruned trees come into bearing earlier and produce more fruit than those pruned heavily.

Branch from lightly pruned tree showing growth and pruning habit.

In training and pruning young apple orchards, growers should train their trees to the modified leader and practice light pruning as this combination has produced larger trees, earlier production and greater production.

Hardiness of Peach Varieties for Western North Carolina

This work is being conducted primarily for the purpose of comparing those varieties that withstand low temperatures in the North with our

southern varieties as regards resistance to cold in the mountains, to determine if any of the hardier northern varieties will be better adapted to our mountain conditions than the varieties now being grown.

Notes are taken each year on the hardiness of the buds and hardiness of trees.

Data collected to date indicate that there is very little difference in northern and southern varieties as regards hardiness of buds, but that the northern varieties of Crosby, Engle and Kalamazoo are outstanding as regards hardiness of trees.

Branch from heavily pruned tree. Note very little growth and fruit.

Variety Testing of Pecans

Results of past seasons indicate the desirability of confining commercial plantings of pecans to the Coastal Plain section of the State. The Stuart, Schley, Alley and Success varieties have proved the most desirable from the standpoint of yield and quality.

All other pecan project reports are based on crop production, and as there were no yields in 1925, no individual reports can be made.

ROTUNDIFOLIA GRAPES
A Study of Inheritance of Quality Characters

The data collected show the following results: The clinging quality of the berry apparently does not exist within the species and is not inherent as a unit character, but is probably a problem of abscission.

The size of clusters and thickness of skin are inherited but are not unit characters and are as much or more influenced by environment. Recent results indicate that size of berry may be inherited.

In a study of the inheritance of size, a vine with berries of medium size was crossed with a vine of large berries on the one hand, and one with small berries on the other. The following table supplies the results:

Beulah X Seedling M		Eden X Seedling M	
Beulah diam.	20.8 mm	Eden diam.	15.2 mm
Seedling diam.	18.7 mm	Seedling diam.	18.7 mm
Average F_1 diam.	20.4 mm	Average F_1 diam.	16.3 mm
Range F_1	16.7-23.9	Range F_1	13.4-19.3

Hybridization With Other Species

Attempts have been made to hybridize Vitis rotundifolia with 13 other species of Vitis and with 11 varieties of Euvitis hybrids (see table). Seven direct crosses with Vitis were obtained and four reciprocal and five direct and no reciprocal with bunch grapes.

This species hybridize most easily with Vinifera and such northern species as Labrusca, and also easily with such species as Arizonica and Californica.

Hybrid offspring continues to show marked sterility and low vigor. Numerous attempts have been made to get an F_2 generation, using 20 different combinations, but only three seedlings were secured.

Hybrids with bunch grapes may be considered practically sterile.

Crosses With V. Rotundifolia As the Staminate Parent

Successful	Unsuccessful
Labrusca	Lincecumii
Vinifera	Baileyana
Cineria	Champini
Bicolor	Longuli
Cordifolia	
Bourguiniana	
Aestivalis	

Crosses With V. Rotundifolia As the Pistilate Parent

Successful	Unsuccessful
Vinifera	Labrusca
Cineria	Bicolor
Bourquiniana	Cordifolia
	Lincecumii
	Aestivalis
	Arizonica
	Californica
	Candicans

HYBRIDIZATION OF VITIS ROTUNDIFOLIA WITH HYBRIDS OF EUVITIS SPECIES

Crosses With V. Rotundifolia As Staminate Parent

Successful	Unsuccessful
Labrusca X Vinifera	
Agawam	Wilder
	Salem
	Marguerite
	Lindley
Labrusca X Aestivalis	
Gold Coin	
Lincecumii X Ruprestris	
America	
Lincecumii X Labrusca	
Beacon	
Lincecumii X Bourquiana	
Muench	
Labrusca X Vinifera X Aestivalis	
Winchell	

All reciprocal crosses were uniformly unsuccessful.

Storing First Crop Irish Potatoes In Sweet Potato Storage House

Each year potatoes of the Irish Cobbler variety have been harvested and stored in early summer, and records secured in the fall. The following table supplies the results of this year's work:

Date	No. of Potatoes	Weight	No. Potatoes Rotted	Loss in Weight Lbs.	Condition
June 24	409	127 lbs.			Firm
Oct. 8	406	122 lbs.	3	5	Firm, few beginning to shrivel.

The results of this year confirm previous work to the effect that the sweet potato storage houses in Eastern North Carolina can be successfully used to keep Irish potatoes of the early crop through the summer until October.

Value of Different Sources of Irish Potato Seed

This project has been conducted for six years, results indicating that North Carolina mountain grown seed is the equal of Maine grown seed for use in Eastern Carolina. The following table supplies the results of this year's work:

Source	No. 1's Yield Per Acre Bushels	No. 2's Yield Per Acre Bushels
North Carolina	99.69	56.47
Maine	100.26	58.77

Results secured indicate the value of Western North Carolina seed. These investigations have opened up new possibilities in potato growing in Western North Carolina and many growers are producing Irish potato seed for use in Eastern Carolina.

Effect of Different Cultural Practices On Yield of Irish Potatoes

To determine the effect of different distances between rows and different distances apart in the row on yield of Irish potatoes, the following table supplies results secured this year at the Coastal Plain Station with the early crop of Irish Cobblers:

Spacing	No. 1's Yield Per Acre Bushels	No. 2's Yield Per Acre Bushels
3 ' x 9"	203.99	40.31
3 ' x 12"	187.88	23.65
3 ' x 15"	168.24	30.56
3 ' x 18"	145.77	20.19
2½' x 15"	255.23	24.90
3½' x 15"	195.12	19.26
4 ' x 15"	168.13	17.57

The results of this year, as well as the results secured in former years, show that closer spacing in the row and between rows produces heavier yields in seasons with normal moisture supply. Results have been secured, however, in dry seasons that indicate that close spacing will reduce yields. It may be generally concluded that closer spacing in the row and between rows will prove desirable over a period of years for conditions in Eastern Carolina.

Effect of Different Cultural Practices On Yield of Sweet Potatoes

This work has been conducted for four years, and the work of the present year confirms the results secured in other years. The following table supplies the results of four years' work on this project:

Distance Apart	Average Number Bushels for Four Years
12 inches	167.35
18 inches	150.31
24 inches	148.75

All plantings in three-foot rows.

It will be noted from the above table that planting 12 inches apart in the row gives higher yields than greater distances. Notes on the type of potatoes in connection with this work indicate that potatoes of more uniform size and shape are produced also at the shorter distances. Growers in Eastern North Carolina should adopt the practice of planting at from 12 to 15 inches apart in the row.

Sweet Potato Storage

Potatoes were dug at different periods in the fall and records taken in the spring to determine the effect of time of harvest and maturity and frost on the keeping quality of potatoes. The following table supplies results of this work:

No. Crates	Date Harvested	Date Taken From Storage	Per Cent Loss In Storage
4	9-28-25	3-17-26	0.75
4	10-27-25	3-17-26	0.30
4	12- 1-25	3-17-26	72.00

Results show conclusively that if potatoes are allowed to stay in the ground until the vines have been killed by frost and the potatoes affected by low temperatures, they will not keep successfully in storage. Growers in North Carolina should harvest their potatoes just before the vines are killed by frost, and if the vines have been killed by frost the potatoes should be harvested immediately.

Photographs made in March of potatoes stored in sweet potato storage house during previous fall. Potato No. 1 harvested before frost and is in sound condition. Potato No. 2 shows result that often follows when potatoes are dug after vines have been killed by frost.

Sweet Potato Fertilizer Tests

To determine the best source of nitrogen for sweet potato fertilizers in Coastal Plain soils. The following table supplies the results secured this year:

Fertilizer P-N-K	Source of Nitrogen	Total Yield Per Acre Bushels
8-3-6	Nitrate of Soda	204.28
8-3-6	Blood Tankage	186.42
8-3-6	Sulphate of Ammonia	217.14

Six hundred pounds per acre applied in the hill.

This year's results indicate ammonium sulphate as the source of nitrogen gave a better yield than nitrate of soda or tankage. It would seem from these results that the more valuable forms of nitrogen such as sulphate ammonia and nitrate of soda are the best sources of nitrogen in sweet potato fertilizers.

Lettuce Tipburn Investigations

In the last three years the lettuce industry in the Wilmington section has been very seriously threatened by the trouble known as "lettuce tipburn." Preliminary investigations consisting of surveys of the different lettuce

fields to determine the relation of different cultural practices to the trouble were conducted. No definite indications were secured as a result of this survey. This year definite investigations were started at the Lower Coastal Plain Station to both study the nature of tipburn and the effect of different treatments on the trouble. On April 19 plats were laid out and apparatus set out as follows:

1. Ten-inch boards were set on edge just outside of the lettuce rows.
2. A section was shaded with burlap.
3. A section was irrigated each morning by means of thorough irrigation.

The following instruments were set up and records taken regularly:

1. A set of maximum and minimum thermometers placed close to the ground in an exposed place. Readings were taken each day.
2. An anemometer was set up in the field with the cups 18 inches from the ground. Readings were taken each morning and night.
3. Soil temperatures were secured in the morning, noon and night by means of soil thermometers.
4. A self-recording hygrothermograph was placed under shelter in the field.
5. The relative evaporation was determined by means of atmometers placed with the bulb just above the ground. Records were taken each morning and night.
6. On hot days the temperature of lettuce heads was determined by inserting a thermometer into the heads.

Lettuce test plats used in tipburn investigations at Coastal Plain Station, Willard, N. C.

All the plats showed high percentages of tipburn and the amount of tipburn was in direct proportion to the number of plants which headed up. The irrigated plat made the earliest heads and burned worse than some of the others. In the shaded plat few plants headed up, however, every plant that headed showed tipburn.

Upon close examination of the leaves forming the lettuce heads, a number of small brown spots were noticed in many cases, near the edges of the leaves. In almost every case these spots were followed by browning or breaking down of the tissues, as in tipburn. Upon microscopic examination it was found that these brown spots were undoubtedly caused by insects. There may be some relation between these injuries and tipburn, as in the case of tipburn on Irish potatoes.

No definite conclusions can be drawn from the first season's work except that burning is as severe in the shade as in direct sunlight. None of the cultural practices gave any differences in results in regard to tipburn. Irrigation seemed to increase the amount of burn.

Some of the equipment used in tipburn experiments.

Lettuce Investigations

The objects of this investigation are as follows:

1. To determine the conditions which cause tipburn of lettuce.

2. To develop a resistant strain of Big Boston lettuce.

3. To develop a strain of New York or Iceberg which will consistently form solid heads in the Wilmington section.

Twenty-two fields were visited at least three times each, and some four times. Fields were selected in different parts of New Hanover County in order to get representative growers and various types of soil. Also special endeavor was made to select growers who used different fertilizer combinations. In one field no mineral nitrates were used in the fertilizer. In this field tipburn was heavy, being approximately 25 per cent. In another field Nitrapo was used as a top dressing, and in this field there was approximately 50 per cent of burning. In the third field of 12 acres on light sandy soil, nitrate of soda was used as a top dressing, and the burning was only 1 per cent.

On the farm of J. P. Herring, at Wilmington, a number of different strains of New York variety of lettuce was planted for the purpose of finding a strain which would head up well under our climatic conditions. Two of these strains showed up very well this season.

In those fields where the smallest amount of tipburn was noted, plants were selected and seed secured to determine whether or not strains resistant to tipburn may be produced.

The amount of tipburn in the various fields as noted in the final inspection would indicate that the burning was not influenced by fertilizer combinations, top dressings, the use of organic or mineral nitrogen, or the method of planting.

C. D. MATTHEWS,
Head of Department.

RESEARCH IN BOTANY

PLANT PATHOLOGY

S. G. Lehman

The Division of Plant Pathology is engaged in the study of the life history and control measures for diseases of our principal field and truck crops. During the past year work has been done on soybean diseases, control of seed-borne diseases with special reference to cotton anthracnose, "take-all" of wheat and wheat rust. The above work has been under the direct charge of Dr. S. G. Lehman, and the following is a report of the progress of his work:

Soybean Diseases

Four papers setting forth the results of some of the work of this project have been submitted for publication. Three of these are descriptive accounts of three minor soybean diseases and bear the following titles: "Soybean Anthracnose," "Brown Spot Disease of Soybeans," and "Pythium Root Rot of Soybean." The fourth paper is a comparison of the soybean diseases of the Orient with those which occur in North Carolina. It seems probable that many of the diseases to which soybeans in America are subject were brought to this country on seed shipped from the Orient. These papers are appearing in the August 15, 1926, number of the Journal of Agricultural Research (Vol. 33, pp. 365-396).

Studies are being made of the cercospora disease of soybean, which was discovered in this State for the first time late last summer. Observations made since that time indicate that this disease is the same as one which was described by Miura from South Manchuria in 1918, as caused by Cercospora Daizu Miura. Indications are that the disease is seed-borne, and an experiment is being made to test this point, but since the disease has not reappeared in the present season up to the end of the time covered by this report, no definite statement can yet be made in regard to this question.

An effort is being made to determine the value of seed treatment in control of certain seed-borne diseases of soybeans. Mammoth Yellow seeds from plants which were diseased with mildew (Peronospora manshurica) and bacterial blight (Bact. sojae) were treated with various chemical disinfectants such as formaldehyde, mercuric chloride, and several organic mercury compounds. Owing to the very unusual dry weather of the past spring these seed could not be planted until June 15. The results of this work will be reported next year.

As a part of the work on seed disinfection in control of diseases, a test was made to determine the effect of different seed disinfectants on germination of soybean seeds. The solutions were used in different concentrations and for different periods of time, and the seed were germinated in soil in the greenhouse. Formaldehyde in all concentrations used reduced the germination of the seed very materially. Solutions of Semesan and Uspulun, and Bayer Dust, and Semesan applied as a dust increased the percentage

of germination. Mercuric chloride gave neither reduction nor significant increase in germination. Seeds of only one variety of soybean, Mammoth Yellow, were used in this test. Other varieties will be tested later. The results so far obtained indicate that formaldehyde should never be used as a disinfecting agent for soybean seeds. Furthermore, it appears from these tests that the gain in germination of soybean seeds due to the use of organic mercury disinfectants may be of sufficient consequence to make seed treatment profitable entirely apart from any benefit accruing from control of seed-borne diseases.

A test for control of Sclerotium rolfsii on soybeans was again made on the farm of Mr. T. W. Griffith, in Bertie County. Ground limestone was applied to parts of this plot in the fall of 1924 at the rate of 1¼ tons and 2¼ tons per acre. As reported last year, this treatment neither reduced nor increased the proportion of soybean plants attacked by Sclerotium rolfsii. In the spring past soybeans were planted on the same piece of infested land. Immediately after the seeds were planted solutions of formaldehyde, mercuric chloride, and an organic mercury preparation were poured on top of the row. These treatments did not reduce the stand of beans nor did they reduce the number of diseased plants below that occurring on the check rows. However, the number of diseased plants in the check rows were very small, due very probably to the dry season, hence no conclusion can be drawn from this test as to the efficiency of this treatment. It appears, however, that the disinfecting solution could have been applied in somewhat larger quantities without reducing the germination of the seed.

Control of Seed-Borne Infection

This project has been directed very largely to the control of cotton anthracnose by the use of dry heat. The results of work reported previously show that this disease may be controlled by the application of dry heat to infected seed without seriously reducing their germination. The aim of the work of the past year has been to find a satisfactory way of using this method with large quantities of seed.

Following the suggestion of a number of persons, an attempt was made to use a tobacco curing barn for this purpose. The barn which was used is located on the Tobacco Station, near Oxford. It is a frame structure with a concrete foundation. The outer wall consists of a layer of sheathing nailed to the studding, and covered with building paper which is in turn overlaid with weather boarding of square-edged, unplaned boards. The roof is of galvanized iron covering weather boarding and sheathing. A loosely-fitting ventilator runs along the ridge for half the length of the barn. The heating equipment consists of two kerosene oil burners of the gravity system, each having a smoke pipe extending up through the roof of the barn. The cotton seeds to be treated were spread on galvanized wire cloth stretched at two different levels across the poles of the barn. The bottom layer of seeds was on the lowest poles of the barn and about 7½ feet above the first floor. The upper layer of seeds was on the third row of poles, that is, two poles above the bottom layer. Vacant spaces were left in the bottom layer to facilitate the passage of hot air to the upper

layer of seeds. Electrical resistance thermometers made and calibrated in the Botany Department with the assistance of Dr. J. B. Derieux, of the Physics Department, were buried in the seeds at various positions. These were connected to suitable reading instrument located outside the tobacco barn. It was thus possible to follow the temperature changes of the seed without entering the barn. Temperature readings were made at frequent intervals and a record kept for the entire period of treatment.

The results of this test show that the tobacco barn as at present built and equipped cannot be used satisfactorily for treating cotton seed to control cotton anthracnose.

The most serious obstacle encountered is the difficulty of keeping the temperature sufficiently high during the last stages of the treatment. In order to kill the anthracnose organism in the seeds a temperature of 95 degrees C. must be maintained for ten to twelve hours. While this temperature was obtained at certain favorable positions, as directly above the burner, during the warm part of day, it could not be maintained during the cool part of the day nor night. Outdoor temperatures at the time of this test ranged from 10.5 degrees C. at night to 28 degrees C. during the warmest part of the day. If cotton seed are to be treated in tobacco barns the work must be done some time between ginning and planting time, that is, during the part of the year when outdoor temperatures are lower than those obtaining during the curing season for tobacco. Moreover, since in treating cotton seed higher maximum temperatures must be obtained than are used in curing tobacco, the capacity of the heating plant must be increased or the insulation of the barn improved. This test indicates that the difficulty of obtaining and maintaining a temperature of 95 degrees C. during the cool part of the day can best be overcome by use of a barn having both inside and outside insulation with an enclosed dead air space.

Another difficulty encountered lay in the variation of temperature between different positions on the same shelf and between similar positions on the two shelves. Temperatures toward the sides of the barn were always lower than toward the positions of the heaters in the middle of the barn. These differences at times were as low as 2 degrees C., but during most of the treatment amounted to 6 to 10 degrees C., a variation entirely too large for satisfactory results. This difficulty would be largely overcome by use of a barn with double wall insulation as suggested above and by a more favorable distribution of heaters such as four or six small heaters placed toward the sides of the barn instead of two large heaters in the middle. The installation of fans to increase the circulation of the heated air would further alleviate this difficulty.

It is thought that with the improvements noted above treatment of cotton seeds in tobacco barns is a feasible proposition and that the operation may be entrusted to persons accustomed to the close attention requisite to the proper curing of tobacco.

Thirty bushels of seed were treated in this test. Approximately ten gallons of kerosene oil were used. At 15 cents a gallon the total cost for oil was $9.00. This amounts to 30 cents for each bushel of seed treated. By use of a barn of improved insulation and a more advantageous arrangement of trays so as to include more seed, the cost per bushel for fuel can be reduced considerably.

The writer is indebted to Mr. E. G. Moss, Assistant Director of the Tobacco Station, for his helpful co-operation in this work.

In another attempt to apply the dry heat treatment to a large quantity of seeds, steam under pressure was used as the source of heat. This work was done at the Upper Coastal Plain Branch Station, and acknowledgment is hereby made to Assistant Director R. E. Currin, Jr., for his hearty co-operation. A small room 5 feet 10 inches square by 9 feet 10 inches high was used. The room was of double wall construction with sawdust packed between. The seed to be heated were placed on trays which were set at an angle and staggered in such a way as to make it necessary for the warm air, in rising from the bottom to the top of the room, to pass under each shelf or tray. A coil of pipes was placed on the floor and on two side walls. From a boiler outside the building steam was forced into the pipes through a reducing valve which automatically maintained the pressure desired in the heating coils. Electrical thermometers were used for measuring temperatures inside the room. A fan system was installed to force the circulation of air.

With this equipment the temperature on the different shelves could be kept very uniform hour after hour. The two lowermost shelves usually ran 2 to 5 degrees C. higher than the remaining shelves, owing to the use of too large a coil on the floor of the room. It is believed that with a slightly different distribution of the heating coils on the floor and walls and a fan built to move a large volume of air temperatures varying not over 2 degrees C. between similar positions on the different trays could be maintained.

The most serious objection encountered in using the equipment described above is that seeds at the end of the trays are nearer the heating pipes than those in the middle, and hence more likely to be subjected to harmful temperatures in the effort to raise the seed in the middle of the tray to temperatures effective in killing the anthracnose organism. This danger could be largely, if not entirely, eliminated by spacing the shelves somewhat further apart or perhaps also by forcing a more rapid circulation of air.

The cost of the steam heating installation is considerably greater than equipment suitable for heating a tobacco barn. The operating cost exclusive of labor is also somewhat higher.

Acid Delinting of Cotton Seed

It is often desirable to delint cotton seed as a measure in control of anthracnose and bacterial boll rot (Bact. malvacearum) and inquiries are frequently received in regard to (1) suitable strength and grade of acid to use; (2) quantity of acid required, and (3) length of time seed may safely remain in the acid. In the absence of published data giving definite information on these points tests were made with a view to assembling data essential to an intelligent answer to these questions.

Our tests showed that if one is working at ordinary temperatures of 65 or 75 degrees F. very good delinting may be obtained in ten minutes with commercial acid of 66 degrees Baume' strength. Under the same conditions but with acid of 52 degrees Baume' delinting does not occur even though the treatment lasts for hours and one uses a small quantity of seed

in a relatively large quantity of acid (excess of acid). With 58-degree acid delinting is poor. When 60 and 61-degree acid is used the treatment must be continued for 60 minutes and even then delinting is only fair to good in character. If one maintains the seed and acid at a temperature of 120 to 130 degrees F. during the treatment acid of 53 degrees Baume' will delint seed perfectly in ten minutes. The difficulty of maintaining this temperature will add to the trouble and expense of the treatment to such an extent as to more than offset the lower price of the low grade acid. Moreover 66-degree acid will delint considerably more seed in a given time than acid of a lower concentration. The saving in the quantity of acid required, the greater completeness of delinting and economy of time makes it advisable to use 66-degree acid whenever acid of this strength can be obtained.

Tests on the quantity of acid required showed that two quarts of acid will delint one bushel of seed in ten minutes. It is probable that the least quantity of acid required to delint one bushel of seed is even less than two quarts; but in practice it will be found advantageous to use two and one-half or three quarts of acid per bushel of seed. This is because of the mechanical difficulty encountered in stirring so large a volume of seed into so small a volume of acid thoroughly enough to coat every seed with acid.

With 66-degree acid delinting is usually complete in 10 to 15 minutes. In certain tests the seed were left in such acid for 20 to 24 hours. In every instance seed so treated germinated as well or better than the untreated checks.

Wheat Take-All

The studies on wheat take-all are in co-operation with the Office of Cereal Investigations, U. S. Department of Agriculture. A large number of varieties and selections were planted on the same piece of infested land which had been used for this purpose for the two previous years during which this work has been in progress. The result of the past season's test was both interesting and surprising. Very little take-all was in evidence. Susceptible varieties which in the two previous seasons were greatly reduced in stand and yield of grain by take-all showed in this season only a trace or none of the disease. The cause of this low incidence of disease is not fully known but it is ascribed to the somewhat unusual seasonal conditions, very favorable for wheat development, which prevailed during the past spring. It will be of more than passing interest to determine if the disease is permanently reduced in virulence or will return another season with renewed vigor.

Wheat Rust

This project is being conducted in co-operation with the Department of Agronomy of this station and the Office of Cereal Investigations of the U. S. Department of Agriculture. The purpose of this is to find a variety or varieties, which are markedly resistant to rust, particularly leaf rust, and at the same time well adapted to our climate. A large number of varieties and selections were planted on the Mountain Branch Station Farm at Swannanoa and on a privately owned farm near Marshall.

Neither leaf nor stem rust appeared on the planting at Swannanoa up to the time of harvest. This planting was on high ground. At harvest time Leap's Prolific and Fulcaster growing on bottom land on the same farm and maturing later than wheat on high ground, were badly infected with leaf rust, both telia and uredinia being present in abundance.

On the planting near Marshall no rust appeared up to May 20, at which time the heads of the earliest varieties were half way out the boot. By June 16 leaf rust had appeared as a trace on all the varieties and in amounts up to 100 per cent infection on other varieties. Data showing the yields and indicating the comparative resistance of these varieties and selections to leaf rust was obtained.

By June 16 stem rust in light form had appeared on one row of one variety only. By harvest time a trace of stem rust was to be found over the entire planting. The amount of infection which reached 100 per cent in one portion of the planting was not at all uniform, varying from a trace or none at all to 100 per cent on the same variety. A more favorable year for rust should give us stem rust data of great significance.

On March 1, 1926, Dr. R. F. Poole, formerly of the New Jersey State Agricultural Experiment Station, took up work in this department. Dr. Poole is devoting his time in the main to a study of dewberry and sweet potato diseases.

B. W. WELLS,
Head of Department.

AGRICULTURAL ECONOMICS

FARM ORGANIZATION AND MANAGEMENT

Research work in farm organization and management consists of three projects as follows:

1. **Farm Organization and Management in the Coastal Plain.** This project has been completed and the results published in Research Bulletin No. 1. In the bulletin are presented three standard farm organizations which are considered more profitable than those usually followed by farmers in the area. For example the standard 30-acre farm shows a net profit of $270 over the best 30-acre farm studied; the standard 50-acre farm, the net gain over the best farm of this size was over $600, and the standard 80-acre farm showed a net gain of over $1,000.

In presenting these standard farm organizations detailed tables have been constructed showing just how the farmer may organize his farm in order to secure results comparable to those of the standard. That is to say, crop rotations, feed requirements, for all classes of livestock, labor distribution by crops and for work on livestock, and fertilizer requirements suitable for each standard acre shown. These various tables, it is believed, give the necessary basis for farmers to reorganize their farms for more efficient production.

2. **Farm Organization and Management in Tidewater Area.** This study is similar in motive to the one described above. The field work has been completed, and the data are tabulated and ready for analysis. A bulletin setting forth the results will be prepared for publication during the year 1927-28. In this bulletin it intends to show the place of hog production, which is becoming an important enterprise in this area, in the farm business. Special attention will also be given to sweet potatoes, peanuts and corn which are supplementary enterprises on most farms. Some of the better farms will be analyzed and presented in detail and standard farm organization involving all of the above crops in different combinations will be shown.

3. **Farm Organization and Management in the Mountain Area.** The field work on this project is in progress. The data are being posted as rapidly as received from the field. The data will be analyzed in a similar manner as described above under 1 and 2.

4. **The Study of Cotton Gins.** A study of cotton gins for the purpose of determining how they were operated was conducted in 1925. The schedules have been edited but the data have not been analyzed. The analysis, when made, hopes to show how the ginning of cotton may be conducted more efficiently. The work was conducted in co-operation with the United States Department of Agriculture. The department has conducted similar studies in Texas. These data will also be available for comparative purpose. It is believed that a satisfactory study of interest to the cotton ginners can be made; showing the cost of operation and pointing out how these costs may be reduced.

5. A Study of Land Prices in Rockingham, Person and Caswell Counties. The field work on this project has been completed, the data tabulated and results partly analyzed. The work was done in co-operation with the United States Department of Agriculture. The department has gathered information for various parts of the United States. These data will be available for comparative purposes. When the final editing of the data is made it will then be possible to correlate the land prices with the various factors mentioned in the project statement. The work on this phase of the project will be completed during the year 1927-28.

G. W. FORSTER, Agricultural Economist.

RURAL SOCIOLOGY

A STUDY OF THE STANDARD OF LIVING OF 1,000 FARM FAMILIES IN NORTH CAROLINA

1. The expenditures of the family budgets have been thoroughly analyzed and it has been ascertained what portion of each budget went for each of the consumption items in the standard of living.

2. It is found that as the incomes and, therefore, the expenditures decrease, the per cent spent for food, clothing and housing increases and the per cent spent for all other items decreases.

3. It has been discovered that even with 1,000 schedules the number is not great enough to do much by way of statistical correlation. This is due to two facts:

(a) When the schedules are separated into landlord, owner, tenant, and cropper groups, the members become too small to make statistical conclusions possible.

(b) If not so divided the major correlation, that with income, is not possible.

The data are thoroughly tabulated and classified. There can be no question about the value of the findings. They may, however, have to be stated chiefly in statistical tables rather than in terms of correlations.

4. The data will be written up before January 1, 1927.

W. A. ANDERSON.

MARKETING

A STUDY OF THE MEMBERSHIP PROBLEMS OF CO-OPERATIVE MARKETING ASSOCIATIONS

1. Definite and detailed interviews have been held with 558 farmers in 13 counties of the State. They gave information, opinions and attitudes in such form that their answers have been tabulated. From this information it is now possible to assert that lack of knowledge (a) of the economic principles and problems involved in marketing; (b) lack of information on the activities of their officials; (c) having signed contracts under misconceptions are the chief sources of membership problems. Additional reasons are (d) the fact that growers are obligated by crop mortgages to such an extent that they cannot deliver their crops to the associations, and (e) they have, in some cases, been influenced by propaganda against co-operative marketing.

2. The interviews with business and professional men, of the same communities as those in which growers were interviewed are not yet complete.

3. The study of the co-operative headquarters, their attempts to handle membership problems and the results have just begun.

4. The project will be completed during the year 1926-27.

R. W. GREEN.

RESEARCH IN ENTOMOLOGY

The larger portion of the research work which has to do with studies of the life history and control of injurious insects is being conducted in the Department of Entomology of the State Department of Agriculture. This is the only research group that has not been taken over by the College. It is planned, as early as funds are available, to establish this work along with the other research departments of the College.

The following report concerns research which has been supported by the research funds in co-operation with members of the teaching staff of the College:

THE BEAN LEAF HOPPER

This pest is of economic importance to the following crops: Cotton, soybeans, peanuts, Irish potatoes, garden beans, cowpeas and to a long list of flowers and ornamental plants.

Some time has been devoted to a study of the effects produced by this insect on the various plants which it attacks. Several entomologists have studied and described the condition known as tipburn, or hopper burn, of Irish potatoes so that the symptoms are very well known. This condition brought about by the bean leaf hopper starts at the tip of the individual leaflets which soon turn brown. If the attack is severe the whole leaflet turns brown, or black, and in very severe attacks the whole leaf, or even the whole plant, may become involved.

Practically the same effect is produced on the peanut by the attack of this insect. Fortunately the peanut plant seems to be able to grow away from this condition. This condition is known among peanut growers as the "pouts" and there is a common saying among peanut growers that "peanuts do not begin to make until after they have had the pouts." Needless to say, an attack of an insect pest such as this can hardly be of any real benefit to the crop.

On garden beans, soybeans and cowpeas this insect produces a peculiar wrinkling of the leaves that is very characteristic. Such plants do not make a satisfactory growth nor produce satisfactory fruits.

The bean leaf hopper seems to damage cotton chiefly while the plants are small, producing a peculiar stunting of the cotton plant. In the insectary we have had plants that were twice as tall and three times as thrifty generally as plants growing in the same plots on which we had placed a single pair of leaf hoppers. When it is recalled that it is not unusual to find whole fields that will average as high as a dozen or two leaf hoppers to a single plant and that in one case 43 adults and nymphs were counted on a single plant, we can have a true appreciation of the damage that this insect is capable of doing. As in the case of the peanut, the cotton plant seems to be able to grow away from the attacks of this insect and to recover to a considerable extent; however, the maturing of the cotton plant is very materially delayed which would be especially bad in case of heavy boll weevil damage. So far as our observations have gone, plants severely attacked do not entirely recover but continue to make poor growth with very few fruiting branches.

On the flowering plants that I have studied this insect produces characteristic pale spots and a stunting of the plant, together with a failure to develop flower clusters.

An attempt was made to devise a suitable hopper dozzer that would be successful against this pest, but the percentage of insects captured was always small. This was especially true of the nymphs which refused to leave the plants.

A satisfactory remedy was developed by using calcium cyanide diluted with two parts of sulphur. This material gives off the deadly fumes of hydrocyanic acid gas. In one case where individual rows of garden beans were dusted the gas killed the leaf hoppers not only in the adjoining rows, but in the rows next to them. Certain varieties, notably the Hermann, of soybeans, are very resistant to leaf hopper attacks, even when grown in the same field, and growers should be encouraged to use this variety.

The grape leaf hopper is a well-known pest of bunch grapes and does considerable damage to this variety of grapes every year. This past year we had a report of this species as damaging muscadines in Cumberland County. This pest needs to be watched closely, for up to the present time this variety of grape has had no serious insect pests.

Leaf hoppers of several different kinds are important pests, especially in the mountains. In the past we have collected them in mountain pastures at rates ranging from fifty to seventy-five per square foot. This past year, due no doubt to the long, continued drouth, the average number of leaf hoppers collected per square foot was from five to ten, while the highest number collected on a given square foot was twenty-six. There is no doubt that even this smaller number is a very severe tax to pasture lands, especially during the dry summer months, and a satisfactory type of hopper dozzer would undoubtedly be profitable.

The rotation experiment for the control of the corn root worm has been continued at Willard, but it has not run for a sufficient number of years to draw reliable conclusions.

Z. P. METCALF,
Head of Department.

POULTRY RESEARCH

The poultry research for the past year has consisted of studies with different sources of high-protein feeds, commercial flock management and breeding studies, and several phases of fowl disease problems. The feeding work is giving very definite information upon the cost of producing poultry at different stages of development, and the influence of feeds upon health and egg production. The breeding studies have for their purpose the studies of inheritance in egg production and the development of simple methods for increasing production by breeding. The disease work includes studies of sanitary measures necessary for the control of white diarrhea, the respiratory diseases of the domestic fowl, contagious diseases among chicks, and the bacteriophage as applied to germ-borne diseases of the domestic fowl.

The research laboratory is located at State College, as is also the Central Experimental Poultry Plant. Projects are also carried at the Mountain Branch Station, near Swannanoa, and at the Coastal Plain Branch Station, near Willard, N. C., through the co-operation of the State Department of Agriculture.

FISH MEAL VS. MEAT MEAL IN EGG PRODUCTION

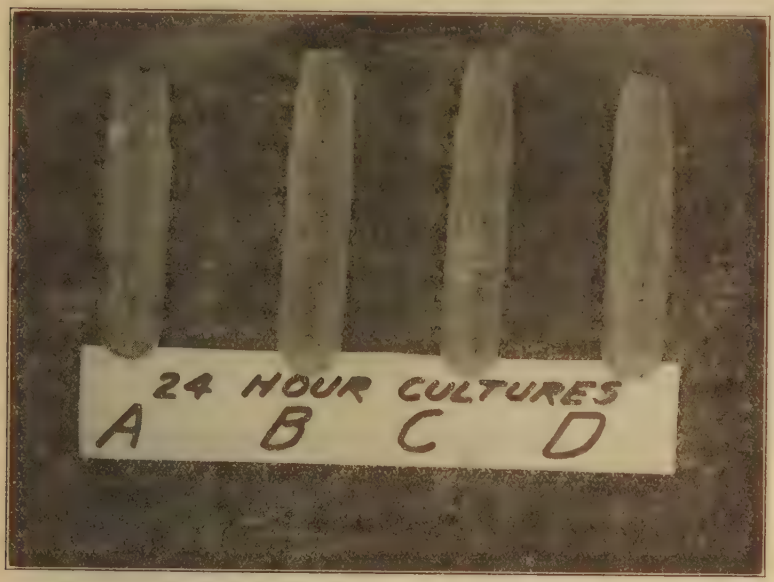
This work has been carried on at both the Central Station at Raleigh, and the Mountain Station near Swannanoa. The work at the Central Station for the year has been brought to a sudden close by thieves stealing all of the hens of one of the flocks. The work at Swannanoa began with the commercial hen year, viz.: November 1, 1925. The basic ration consists of bone meal 4 pounds, fine table salt 1 pound, pulverized oats 20 pounds, wheat middlings 20 pounds, corn meal 35 pounds. To this basic ration there is added 20 pounds of 55 per cent protein fish meal or meat meal as the case may be, making 100 pounds. Each flock received a grain mixture consisting of corn 50 pounds, wheat 20 pounds, and oats 30 pounds. The birds are housed in a half-monitor house. Green feed is supplied each day in amounts of one-half ounce per bird. On November 1, 1925, there were 375 Single Comb White Leghorns in each pen. For the first nine months, or from November 1, 1925, to August 1, 1926, the fish meal birds laid 47,561 eggs, while the meat meal flock laid 48,002. The mortality during this time was 18 deaths for the fish meal flock, and 19 deaths for the meat meal flock. The per cent production for the fish meal flock for the entire nine months was 49 and for the meat meal, 51.

MINERAL REQUIREMENTS IN EGG PRODUCTION

Two pens of Single Comb Rhode Island Red hens were selected for this test. Previous studies have shown that laying hens require mineral supplements, these minerals being sodium, chlorine, and calcium. The mineral supplement and limestone grit were taken away from Pen 15 on May 1.

The percentage production for this pen for April was 70, for May 50, and for June 25. On July 1 the mineral supplement was again resumed. During July the production averaged 32 per cent.

On May 1 the mineral supplement in the mash of Pen 16 was removed but the birds were allowed limestone grit (containing 97 per cent calcium carbonate). The average production of this pen for April was 58, for May 53, and June 32. The mineral supplement was resumed in the mash on July 1. The average monthly production for July was 42 per cent. In each case when the mineral supplement was resumed even though it was the time of year for a gradual reduction of production, there was a rise in the production percentage. There was not as low shrinkage in percentage production when good quality limestone grit was used.



Twenty-four-hour growth of slants flooded with bouillon cultures. Bouillon was seeded with E. Sanguinaria and incubated for 24 hours after it was incubated with a bacteriophage recovered from poultry farm where avian typhoid had been present. Tube A is the control; B, C and D show various actions of the bacteriophage.

RELATIVE VALUE FOR GROWTH OF CONDENSED BUTTERMILK, DRIED BUTTERMILK, MEAT MEAL AND FISH MEAL

In seven tests with fish meal it required an average of 4.16 pounds of feed to produce one pound gain in chicks from hatching to eight weeks of age. This feed cost nine cents per pound gain. In two tests with meat meal it required 4.7 pounds feed to produce one pound gain at a feed cost of 16 cents per pound gain.

In four tests where condensed buttermilk furnished the animal feed it required an average of 3.2 pounds feed to produce a pound gain at a feed

cost of 15 cents per pound gain, and in four tests with dried milk it required an average of 3.7 pounds feed to produce a pound gain at a feed cost of 11 cents a pound. In these tests fish meal was the lowest cost, while dried milk ranked second, meat meal third, and condensed milk fourth.

In the tests run last year fish meal, dried buttermilk, and meat meal were practically the same, with condensed milk last. The cost per pound gain for the two-year average was as follows: Fish meal $0.097, dried milk $0.113, meat meal $0.128, and condensed milk $0.161.

The experimental pens on the Central Experiment Station at State College where experiments on the Bacillary White Diarrhea are being conducted.

RESPIRATORY DISEASES OF POULTRY

Laboratory study was made of 54 cases of respiratory disease, representing types of infection that may occur and involving practically all complications which might be encountered. The evidence brought out in these observations points to the fact that the cases of roup are focal infections which did not produce toxemia of sufficient severity to upset body metabolism. It produces its greatest detrimental effect by the accumulation of an inflammatory product thrown out on the respiratory mucous surfaces, thus obstructing the respiratory passages and also impairing vision by its infection of the eyes.

Artificial infection studies demonstrated that the disease is transmitted by actual contact of normal birds with those diseased, thus accounting for the rapid spread of the disease in the flocks in many outbreaks. In these cases the blood study indicated that the disease produces a stimulation of the manufacture of red blood cells, with a relative increase in the

varieties of leucocytes. The work was based on the complete blood study of 43 cases representing all stages of the disease we met during the past season.

The bacteriological studies demonstrated six groups of organisms commonly associated with the disease process. These groups possess the common features of that group of organisms within which are found a number of the organisms which are pathogenic to the domestic fowl.

In the earlier stages of these diseases cures may be effected, but individual medication in advanced cases is not economical.

Studies of the germ content of the air of poultry houses reveal an excessively bacteria-laden atmosphere. This is differentiated numerically according to the elevation, decreasing with elevation and decreasing with moisture content of the air.

A pullet in the last stages of broncho-pneumonia. Note distressed breathing, unkempt plumage, eyes closed, mouth open, head extended.

BACTERIOPHAGE AS APPLIED TO GERM-BORNE DISEASES

Work is still progressing along this line. There is evidence that a bacteriophage may accompany outbreaks of fowl typhoid. The possibilities of using the bacteriophage as a curative agent is under investigation.

CONTAGIOUS DISEASES AMONG CHICKS

These studies bring out the fact that there are two stages of the chick's growth when it is peculiarly susceptible to infection of coccidia. These stages are from 10 days to 20 days of age, or as brooder chicks and in the range period or from five to seven weeks of age when they are growing the large wing and tail feathers. The disease of coccidiosis is accompanied by a bloody diarrhea, great prostration, spreads rapidly among the flock and causes heavy losses. The treatment found efficient is buttermilk or soured skimmed milk and catechu. Laboratory observations of birds sent for disease diagnosis indicate that this disease is wide spread in North Carolina and is on the increase.

NORMAL HEMATOLOGY OF FOWLS

Complete numerical and differential counts were made on 25 fowls which coincide with our former work and that of other authors. Hemoglobin readings were made on over 2,000 normal birds. These studies indicate a diminishing of hemoglobin during heavy lay and suggests the necessity of an iron supplement in the feed during the season of heavy production.

COMMERCIAL UNIT EXPERIMENTAL FLOCK

The commercial unit experiment to determine the amount of feed to produce a dozen eggs, production in our southern climate, and costs and returns started at the commencement of the present commercial hen year, viz.: November 1, 1925, with 750 hens housed in a half-monitor building 20 by 100 feet with small yards as runs. There were 37 deaths, or 4.9 per cent in the first nine months. The flock consumed 47,182 pounds, or 23.9 tons of mash and grain, which cost $1,081.02. There were produced 7,960 dozens of eggs, requiring 5.9 pounds feed to produce a dozen eggs. The feed cost per dozen eggs was $0.13, which is about one-half of the total overhead according to our previous studies. These eggs were marketed locally (in and around Asheville, N. C.) and brought $3,273.88, leaving a balance above feed cost of $2,192.86.

THE COST OF PUTTING PULLETS INTO LAYING

This test was run on chicks hatched from a flock of Single Comb Rhode Island Reds whose sole source of animal feed was buttermilk, and in a second flock whose sole source of animal feed was meat meal.

The Chicks Hatched From the Milk Flock. It required 464 eggs set to hatch 323 chicks. This was 70 per cent hatch, and 93½ per cent of the chicks were raised. The first pullet laid at four months and 22 days old. The feed cost of 100 broilers at the end of eight weeks was $14.39. The average weight per chick at eight weeks of age was 1.63 pounds. The feed cost per pullet for the first 20 weeks was 60 cents each.

Weights of Chicks at Different Ages

	Milk Test	Meat Meal Test
Weight at hatching	0.09 lbs.	0.086 lbs.
Weight, 4 weeks old	0.49 lbs.	0.42 lbs.
Weight, 8 weeks old	1.63 lbs.	1.17 lbs.
Weight, 12 weeks old	2.34 lbs.	2.00 lbs.
Weight, 16 weeks old	3.27 lbs.	3.00 lbs.
Weight, 20 weeks old	4.03 lbs.	4.02 lbs.

The pullets began to lay at 20 weeks of age. It required 40½ gallons of kerosene at 15 cents per gallon to brood them.

The Chicks Hatched From the Meat Meal Flock. It required 470 eggs to hatch 253 chicks. This was 54.8 per cent of the eggs set. The first pullet laid at the age of four months and 26 days. The feed cost of 100 broilers at eight weeks of age was $9.36. The average weight per chick at eight weeks of age was 1.17 pounds. The feed cost per pullet for the first 20 weeks was 44 cents each. The pullets began to lay at 20 weeks of age. It required 43½ gallons of kerosene at 15 cents a gallon to brood these chicks.

EFFECT OF TURNING EGGS ON HATCHING

The experiments of the effects, on hatching, of turning the eggs one or six times were repeated four times. Similar incubators were used and all eggs were from the same flock. The results were as follows:

	TURNED ONCE A DAY		TURNED SIX TIMES A DAY	
Test	Per Cent Hatch of All Eggs	Per Cent Hatch Fertile Eggs	Per Cent Hatch of All Eggs	Per Cent Hatch Fertile Eggs
No. 1	43.6	48.8	66.0	72.0
No. 2	41.6	52.2	57.0	66.9
No. 3	42.9	52.8	61.0	72.9
No. 4	53.0	59.7	63.0	69.0

In these experiments it indicates that six times turning of hatching eggs from the time of setting to the 18th day will give a greater hatch.

EXPERIMENTS IN FATTENING POULTRY

Two tests were run to determine the relative value of a single fattening ration consisting of equal parts corn meal and pulverized oats fed with twice its weight of buttermilk or sour skimmed milk and a fattening period of two weeks with two-pound broilers and a more complex ration consisting of fish meal 20 pounds, wheat shorts 20 pounds, pulverized oats 20 pounds, and corn meal 40 pounds. In the first test the corn meal-pulverized oats flock gained 58 per cent with a feed cost of 16.5 cents per pound gain and in the second 54.3 per cent gain with a feed cost of 13 cents per pound gain.

The more complex ration showed in the first test 40 per cent gain with a cost of 17.3 cents per pound gain. The second test showed 55.9 per cent gain with a feed cost of 17.4 cents per pound gain. In these tests the more simple rations have given as good results as the more complex rations.

INFLUENCE OF MEAT MEAL VS. MILK IN PRODUCTION AND HEALTH OF FLOCKS

This is the second year of a ten-year project to determine the influence of buttermilk vs. meat meal in the health, quality, and production of the birds. In the nine months from November 1, 1925, to August 1, 1926, the meat meal flock laid 948 dozens of eggs. This flock consumed 6,900 pounds of feed, which cost $168.22. It required six pounds of feed to produce one dozen eggs. The feed cost per dozen eggs was $0.16. The receipts for the eggs were $441.38, leaving a balance of $273.16 above feed costs. The milk flock produced 965 dozens of eggs, and consumed 7,086 pounds of feed. The feed cost $271.18. It required seven pounds of feed to produce one dozen eggs. The feed cost per dozen eggs was $0.28. The receipts at local prices obtained were $435.51, leaving a balance of $164.33. There were 105 hens in each flock on November 1. The high cost of milk has made the feed cost of the milk flock higher than the meat meal flock with a corresponding reduction in profits. The milk flock has laid 17 dozen eggs more, all of which is similar to the results of the first year, but the increase in production did not absorb the increased cost of feed.

INHERITANCE IN EGG PRODUCTION

A male from a low-producing strain of S. C. White Leghorn was mated with females from low and high-producing strains. In the first nine months of the commercial year, or from November 1, 1925, to August 1, 1926, the pullets, 18 in number, from the low sire and low dams laid a total of 1,203 eggs, or 66 eggs per hen for the nine months. The 13 pullets from the same low male but from high dams laid 1,087 eggs, or 82 eggs per hen for the nine months. Conclusions will not be drawn from this experiment until the 12-months period has been completed.

SURVEY OF EXTERNAL PARASITES OF POULTRY

The city of Raleigh survey is not yet completed. A survey of 36 farms in Wake County showed 22, or 52 per cent, infested with lice; 18, or 50 per cent, infested with mites, and 19, or 52 per cent, infested with scaly legs.

A survey was made of 50 farms in Guilford County. Twenty-eight, or 56 per cent, were infested with lice; 30, or 60 per cent, were infested with mites, and 27, or 54 per cent, were infested with scaly legs.

A STUDY OF BACILLARY WHITE DIARRHEA UNDER SOUTHERN CONDITIONS

Twenty-five Single Comb Rhode Island Red and 25 Single Comb White Leghorn hens reacting four-plus in the field testing and certification work were purchased for these studies. During the first ten months these hens laid in the trap nests 3,899 eggs, all of which were cultured. The yolks and albumin were cultured separately. S. pullora was isolated from 225, or five per cent, of the 3,899 eggs laid. There were in addition 258, or six per cent, of the 3,899 eggs infected by other bacteria.

The effect of refrigeration of sera on its agglutination properties was tested over a period of seven months and six days. The serum taken from Single Comb Rhode Island Red four-plus reactors was kept frozen from December 14, 1925, to July 20, 1926. These tests were run in dilutions of 1:25, 1:50, 1:100, and 1:200 and show that the sera retained fully its power of agglutination. The test was run on North Carolina strain S. pullora antigen with the results that the sera retained fully their powers of agglutination.

Trap nest records kept on these birds showed continuous interruption in the egg laying cycle as a result of the focal infection. It is evident from the above that heavily infected birds are uneconomical. Physical studies to date indicate that there is no marked difference in body function as to respiration, temperature, and ability to digest feed. The blood remains practically normal. There are no outward indications that infected birds are such. Autopsy work on birds dying in these flocks confirms the serological test. Monthly blood tests with four antigens reveal that the test is consistently the same. There is demonstrated a distinct cross agglutination with an antigen for avian typhoid which brings up the possibility of the condemning of a bird which possesses immunity from avian typhoid as a reactor for bacillary white diarrhea.

B. F. KAUPP,
Head Poultry Department.
R. S. DEARSTYNE,
Associate in Poultry Disease Research.

LIST OF TECHNICAL PAPERS PUBLISHED OR ACCEPTED FOR PUBLICATION IN OUTSIDE JOURNALS DURING THE YEAR ENDING JUNE 30, 1926

Paper No. 1. Diseases of Soybeans Which Occur Both in North Carolina and the Orient, F. A. Wolf.

Paper No. 2. Brown Spot Disease of Soybean, F. A. Wolf and S. G. Lehman.

Paper No. 3. Pythium Root Rot of Soybean, F. A. Wolf.

Paper No. 4. Soybean Anthracnose, F. A. Wolf.

Paper No. 5. New Species of Megachile, with Notes and Corrections, Theo. B. Mitchell.

Paper No. 6. Tuckahoe on Maize, F. A. Wolf.

Paper No. 7. Human Blood Groups: Their Inheritance and Racial Significance, Laurence H. Snyder.

Paper No. 8. Homopterological Gleanings No. 2: The Types of Certain Genera of Membracidae, Z. P. Metcalf.

Paper No. 9. A Killing Bottle for Collecting Small Active Insects, Z. P. Metcalf.

Paper No. 10. The Genitalia of Some of the Coccinellidae, J. W. Wilson.

Paper No. 11. Studies on Gossypol: The Gossypol and D-Gossypol Content of Some North Carolina Cottonseed Meals, F. W. Sherwood.

Paper No. 12. Studies in Human Inheritance: I. The Linkage Relations of the Blood Groups, Laurence H. Snyder.